

Management Plan for the

Cutlip Minnow (*Exoglossum maxillingua*)



2026

Species at Risk Act
Management Plan Series

Canada

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Preface

Under the *Species at Risk Act* (S.C. 2002, c. 29) (SARA), the federal competent ministers are responsible for the preparation of management plans for species listed as special concern and are required to report on progress 5 years after the publication of the final document on the [Species at Risk Registry](#), and every subsequent 5 years, until its objectives have been achieved.

The Minister of Fisheries and Oceans is the competent minister under SARA for the Cutlip Minnow and has prepared this plan, as per section 65 of SARA. In preparing this management plan, the competent minister has considered, as per section 38 of SARA, the commitment of the Government of Canada to conserving biological diversity and to the principle that, if there are threats of serious or irreversible damage to the listed wildlife species, cost-effective measures to prevent the reduction or loss of the species should not be postponed for a lack of full scientific certainty. To the extent possible, this management plan has been prepared in cooperation with the Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs (MELCCFP), the Ontario Ministry of the Environment, Conservation and Parks (OMECP) and the Ontario Ministry of Natural Resources (OMNR) as per subsection 66(1) of SARA.

As stated in the preamble to SARA, success in the conservation of this species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions and actions for the species' conservation set out in this management plan and will not be achieved by Fisheries and Oceans Canada (DFO), or any other jurisdiction, alone. The cost of conserving species at risk is shared among different constituencies. All Canadians are invited to join in supporting and implementing this plan for the benefit of the Cutlip Minnow and Canadian society as a whole.

A SARA management plan includes measures for the conservation of species of special concern to prevent it from becoming threatened or endangered. The competent minister must prepare a management plan that includes measures for the conservation of the species that the minister considers appropriate. These measures for the conservation of the species are set out to achieve the management objectives identified in the management plan. Implementation of this management plan is subject to appropriations, priorities, and budgetary constraints of the participating jurisdictions and organizations.

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to all individuals and organizations who have contributed to the conservation of the Cutlip Minnow.

Executive summary

The Cutlip Minnow (*Exoglossum maxillingua*) was listed as special concern under the *Species at Risk Act* (SARA) in 2019. This “Management Plan for the Cutlip Minnow (*Exoglossum maxillingua*) in Canada” (management plan) is part of a series of documents for this species that are linked and should be taken into consideration together; including the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) status report(s).

The Cutlip Minnow is a freshwater fish belonging to the Leuciscidae family. This stout-bodied fish measures between 70 and 100 mm in length. It is distinguished from all other North American minnows by its unique tri-lobed lower jaw. Its global range is limited to the Atlantic coastal drainages of northeastern North America. In Canada, it is present in Ontario and Quebec, specifically in the St. Lawrence River and a number of its tributaries.

The threats to the Cutlip Minnow are described in section 5 and include residential and commercial development; biological resource use; invasive and other problematic species, genes and diseases; pollution; and climate change and severe weather, however the level of importance and certainty of these varies.

The management objectives (section 6) for the Cutlip Minnow are as follows:

- I. identify, monitor and reduce the threats posed by widespread habitat degradation and invasive species
- II. determine the distribution of extant populations
- III. improve knowledge of the species’ biological, ecological and habitat requirements
- IV. increase awareness of the Cutlip Minnow and promote public engagement in the conservation of the species
- V. maintain, in the long term, self-sustaining populations throughout the current range of the Cutlip Minnow to ensure the species’ viability in the wild

A description of the broad strategies and measures for the conservation of the species that provide the best chance of achieving the management objectives is included in section 7. These strategies aim, among other things, to fill knowledge gaps related to the Cutlip Minnow’s biology, distribution and threats in order to better plan conservation efforts. Since the species’ range is quite extensive, the coordination of management efforts is another key strategy presented in the plan. In addition to existing provincial and federal legislation that contributes to the protection of the species and its habitat, protection is enhanced through stewardship and outreach strategies.

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1 Introduction

The Cutlip Minnow (*Exoglossum maxillingua*) was listed as a species of special concern under the *Species at Risk Act* (SARA) in 2019. This “Management Plan for the Cutlip Minnow (*Exoglossum maxillingua*) in Canada” (management plan) is part of a series of documents for this species that are linked and should be taken into consideration together, including the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) status report ([COSEWIC 2013](#)). A management plan is a planning document that identifies what needs to be done to arrest or reverse the decline of a species. It sets objectives and identifies measures for the conservation of the species to support achieving the management objectives.

2 COSEWIC species assessment information

Date of assessment: November 2013

Common name of species (population): Cutlip Minnow

Scientific name: *Exoglossum maxillingua*

COSEWIC status: Special concern

Reason for designation: This small-bodied freshwater fish occurs across a relatively small area in eastern Ontario and Quebec where it has been lost from 2 watersheds over the last 10 years. Much of the current range of this species is subject to threats from widespread habitat degradation and multiple invasive species.

Canadian occurrence: Ontario and Quebec

COSEWIC status history: Designated not at risk in April 1994. Status re-examined and designated special concern in November 2013.

3 Species status information

The Cutlip Minnow was assessed by COSEWIC as special concern in 2013 and listed on Schedule 1 of the *Species at Risk Act* in 2019. In Ontario, Cutlip Minnow is listed as threatened under the *Endangered Species Act, 2007*. Based on the current available information, the Cutlip Minnow is not likely to be designated as threatened or vulnerable in Quebec under the *Act Respecting Threatened or Vulnerable Species (1989)* in Quebec. Conservation status of Cutlip Minnow is provided in table 1.

Table 1. Summary of existing protection or other status designations assigned to the Cutlip Minnow.

Jurisdiction	Authority / organization	Year(s) assessed or listed	Status / description	Designation level
Canada	<i>Species at Risk Act</i>	2019	Special concern	Species
Ontario	<i>Endangered Species Act, 2007</i>	2008	Threatened	Species
Global (G)	NatureServe ¹	2012	Global: G5, Secure	Species
National (N) Canada	WildSpecies ²	2020	National: N3N4, Vulnerable	Species
National (N) United States	NatureServe	2012	National: N5, Secure	Species
Subnational (S) Canada	WildSpecies	2020	Ontario: S2, Imperiled Quebec: S4, Apparently secure ³	Species
Subnational (S) United States	NatureServe	2012	Connecticut (S3), Delaware (S4), Maryland (S5), New Jersey (S4), New York (S5), North Carolina (S1), Pennsylvania (S5), Vermont (S3), Virginia (S5), West Virginia (S4)	Species

SARA section 32 prohibitions do not apply upon listing Cutlip Minnow as special concern and, therefore, no permits are required under section 73 of SARA. Further, the identification and protection of critical habitat and species' residence is not required under SARA for species listed as special concern.

The *Fisheries Act* provides for the protection of aquatic species at risk, and provides a framework for (a) the proper management and control of fisheries; and (b) the conservation and protection of fish and fish habitat, including by preventing pollution.

¹ [NatureServe](#)

² [Wildspecies.ca - Exoglossum maxillingua - 2020](#)

³ Centre de données sur le patrimoine naturel du Québec [Quebec natural heritage data centre] (CDPNQ) (2022).

4 Species information

4.1 Species description

The Cutlip Minnow is a small freshwater fish in the Leuciscidae family. This stout-bodied species measures between 70 and 100 mm in length on average but can reach 160 mm (Scott and Crossman 1974; Holm et al. 2010; Desrochers and Picard 2013; Fisheries and Oceans Canada [DFO] 2023). Adults have an olive-grey to olive-green back, silvery sides with a greenish-purple sheen, and a white belly (Holm et al. 2010) (figure 1). Juveniles have a stripe along the midline and a distinct spot at the base of the caudal fin (Van Duzer 1939; Holm et al. 2010). The Cutlip Minnow can be distinguished from all other North American minnows by its unique tri-lobed lower jaw consisting of a central bony tongue-like lobe, 2 lateral fleshy lobes, and no maxillary barbels (Page and Burr 2011). Outside the spawning season, there are no obvious external differences between the sexes. During the spawning season, mature males are darker in colour when viewed from the top, sometimes have a dark lateral band, and develop tubercles on the paired fins (Pappantoniou 1983). The eggs are yellowish and spherical, with one flat edge, and measure between 2.0 mm and 2.6 mm in diameter (Van Duzer 1939; Buynak and Mohr 1980). The species' lifespan is estimated to be just over 4 years (Haase and Haase 1975; Pappantoniou et al. 1984a, 1984b).

There are 2 species in the genus *Exoglossum*: the Cutlip Minnow (*E. maxillingua*) and the Tonguetied Minnow (*E. laurae*). The Tonguetied Minnow is distinguished from the Cutlip Minnow by the presence of a maxillary barbel and a tri-lobed lower jaw which is not as obvious. In Canada, these 2 species are unlikely to be confused because the range of the Tonguetied Minnow is restricted to the United States (U.S.). Within the U.S., the ranges of these species only overlap in southwestern New York (COSEWIC 2013).



Figure 1. The Cutlip Minnow, *Exoglossum maxillingua*. Drawn by Ellen Edmonson. Reproduced with permission by Bureau of Fisheries, New York State Department of Environmental Conservation.

4.2 Population abundance and distribution

4.2.1 Global range

The global range of the Cutlip Minnow is restricted to North America, extending from the St. Lawrence River drainage area and the eastern Lake Ontario watershed to the Roanoke River basin in Virginia, in the northeastern U.S. Its U.S. range includes

New York State, Pennsylvania, New Jersey, Maryland, Virginia, West Virginia, northern North Carolina, western Massachusetts and western Connecticut (figure 2). The species is found in waterbodies in the Adirondack, Catskill and Laurentian mountains as well as in the St. Lawrence Lowlands. In New York State, the Cutlip Minnow occurs in 16 watersheds, and is absent only from the Allegheny River and Erie-Niagara watersheds (Carlson et al. 2016). Transboundary migrations probably occur between New York State and the western portion of the Canadian range, mainly through the St. Lawrence and some of its transboundary tributaries. The Cutlip Minnow is found in the New River system and the Ohio River drainage of Virginia and West Virginia, likely from human-mediated introductions as a bait fish (COSEWIC 2013).

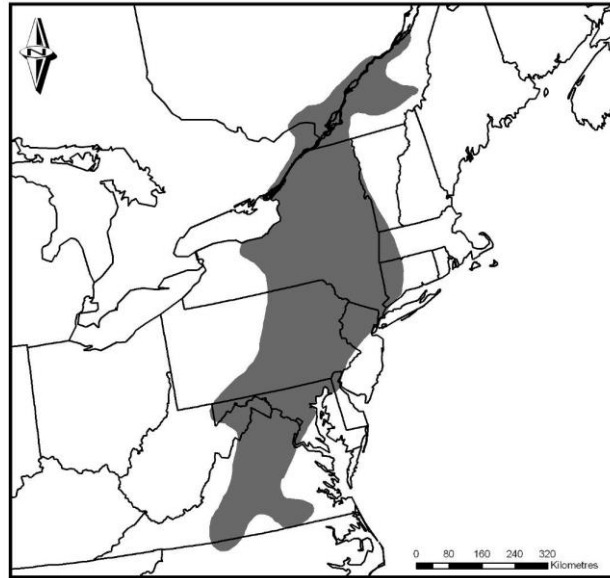


Figure 2. Global distribution of the Cutlip Minnow. Reproduced from the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) (2013) with permission of Environment and Climate Change Canada (modified from Page and Burr [2011]).

4.2.2 Canadian range

Canadian populations of the Cutlip Minnow are found in Ontario and Quebec, including the fluvial section of the St. Lawrence River and its tributaries and sub-tributaries. It was collected in 244 Canadian waterbodies between 1932 and 2022 (appendices A and B). The easternmost record is in a tributary of the Saint-Denis River, near Saint-Pascal, Quebec, and the westernmost, near Ivy Lea, Ontario. The Canadian populations occur in the same national freshwater biogeographic zone (Great Lakes – Upper St. Lawrence) and are considered a single designatable unit according to COSEWIC (2013).

Quebec – The species was first reported in Quebec in 1932, in the upper reaches of the Ulverton River (Saint-François River system) and in several waterbodies in the Nicolet River system. The species has an extensive range in Quebec with records that range from the U.S. border to the Bas-Saint-Laurent region (figures 3 and 4). Since the COSEWIC assessment in 2013, sampling has confirmed the species' presence in many rivers after several decades without records. Recent surveys have confirmed the species' presence in the Chicot, Maskinongé and Yamachiche rivers (Consortium Groupe Hémisphères and Enviro Science et Faune Inc. 2022). Its presence was also confirmed in the Rigaud and Delisle rivers (Écogénie

Inc. 2022a). In addition, specimens have recently been collected in the Nicolet River upstream of Victoriaville, where the presence of several impassible weirs has likely isolated Cutlip Minnow individuals (Écogénie Inc. 2022b). Seine surveys in 2022 validated the species' presence more than 50 years after the last historical occurrences at Lac Saint-Denis and du Diable river in the Laurentians (DFO 2023). Between 2018 and 2020, the Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs (MELCCFP) carried out sampling in the Chaudière and Southwest Nicolet river watersheds to characterize the fish community in stretches where the Cutlip Minnow could be present (Goulet 2019a, 2019b, 2021). The species was found for the first time in several watercourses in these watersheds. Various inventories, not necessarily targeting Cutlip Minnow, have contributed to an improved understanding of the distribution of the species. For example, inventories targeting the Channel Darter (*Percina copelandi*) in the Etchemin River and in the du Nord river have captured the species (Couillard et al. 2018; S. Auger, MELCCFP, pers. comm. 2023). Field work by the Niowentsio Office of the Wendat Nation Council has resulted in the capture of Cutlip Minnow using electrofishing and passive fishing gear (fyke nets) in three new waterbodies: the Champlain (2022), Des Mères (2022) and Trois-Saumons (2019) rivers. These captures took place in three new watersheds where the species had never before been detected. Elsewhere, records in new waterbodies or other areas where the Cutlip Minnow occurs were confirmed in the St. Lawrence River east of Bouchard Island (2015), near Hervieux Island (2015), in South Bluets (2013), L'Assomption (2014), Noire (2015) and Preston (2018) rivers, as well as in the Bécancour River watershed (2019 and 2020) and in Longchamps Lake (2018). The Quebec waterbodies where the species has been found are compiled in appendix A. A number of rivers and streams still need to be sampled to obtain an up-to-date picture of the species' distribution in Quebec.

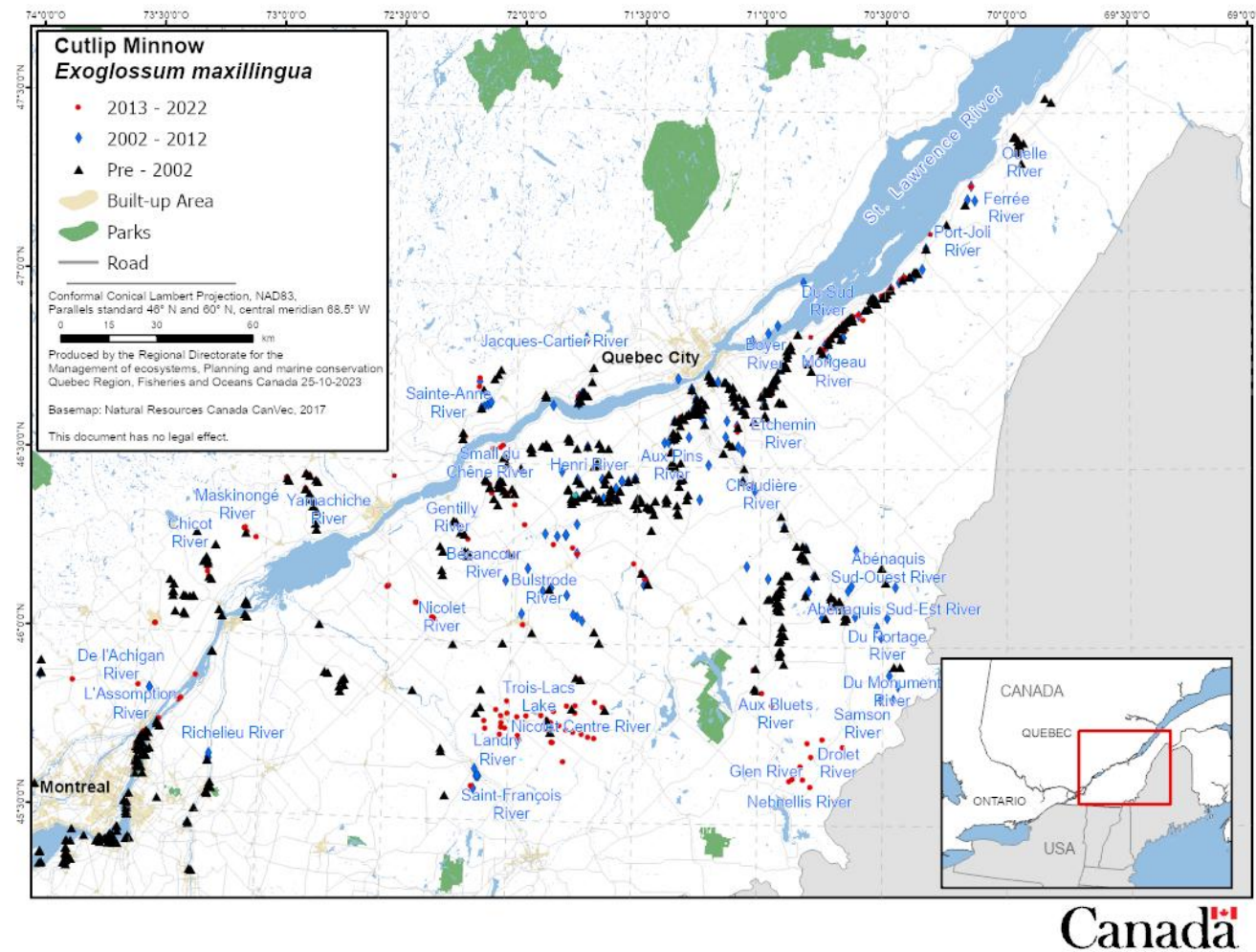


Figure 3. Distribution of the Cutlip Minnow in the eastern part of its range in Quebec. Based on data from the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs (MELCCFP), Fisheries and Oceans Canada (DFO) and other contributors.

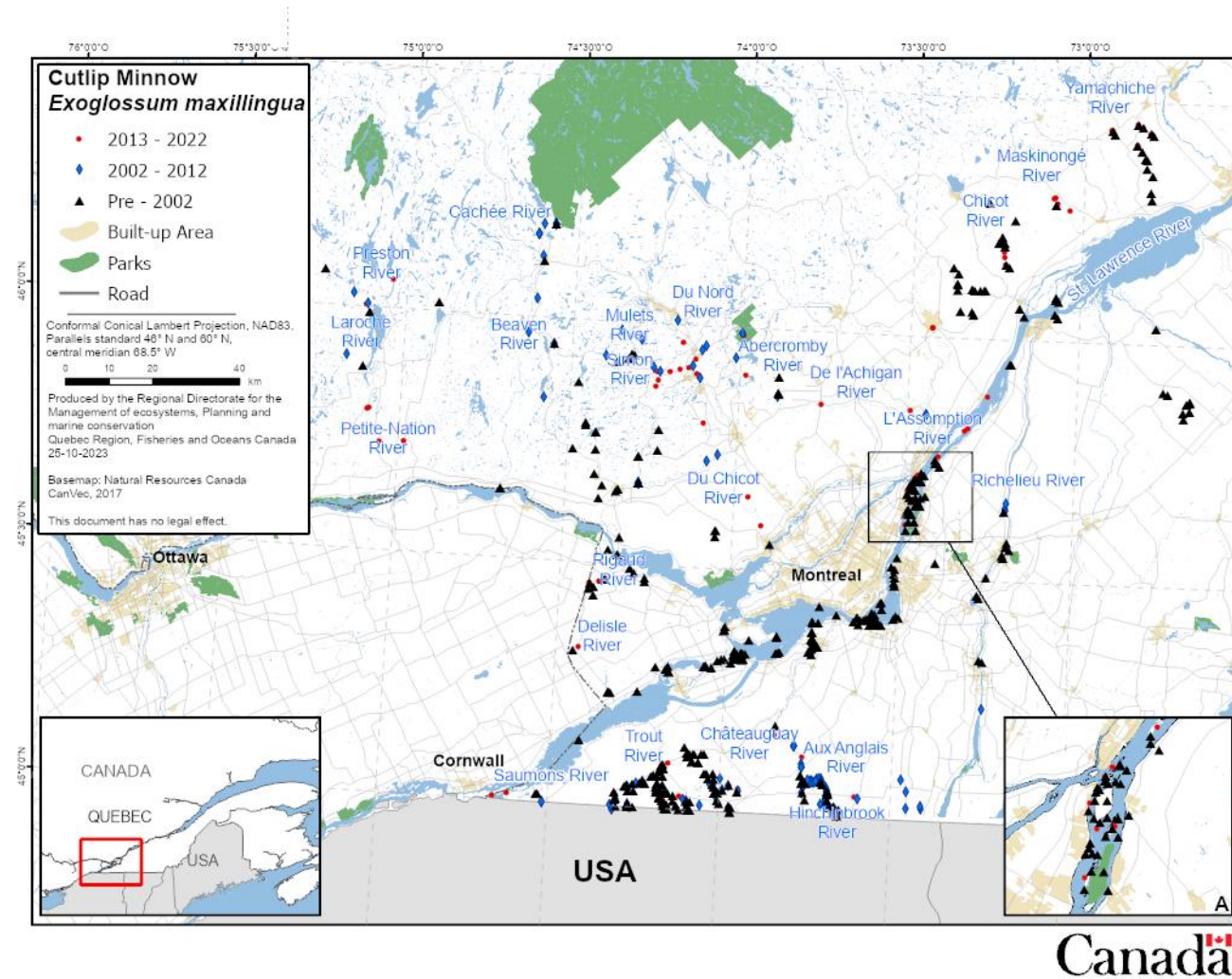


Figure 4. Distribution of the Cutlip Minnow in the western part of its range in Quebec. Based on data from the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs (MELCCFP), Fisheries and Oceans Canada (DFO) and other contributors.

Ontario - In Ontario, the Cutlip Minnow was collected in 7 rivers and streams, including the North Raisin, Raisin and Delisle rivers; Little Rideau, Nash (known as Hoasic) and Rotary creeks; and the St. Lawrence River between Ivy Lea and Lake St. Francis (figure 5). The first records date back to the 1936 to 1938 period and were collected in Ivy Lea, the Delisle River and Rotary and Nash (Hoasic) creeks (COSEWIC 2013). Although there are historical records in the Garry, Beaudette and Rigaud river watersheds, there are no voucher specimens confirming the species' presence in the Ontario portion of these rivers (MacVeigh 2013). Lake Ontario apparently contained Cutlip Minnow in the past, but this cannot be confirmed due to the absence of a voucher specimen (COSEWIC 2013).

Over the last 2 decades, sampling activities targeting the species have been undertaken by Dextrase and Reid (2004), MacKenzie and Hickey (2008, 2010), Hogg (2010), Jacobs (2009, 2010, 2011), the Raisin Region Conservation Authority in 2015 and 2016 and the St. Lawrence River Institute of Environmental Sciences between 2008 and 2018 (L. Ellis, Ontario Ministry of the Environment, Conservation and Parks [OMEC], pers. comm. 2021). Benthic trawling was conducted in the Ottawa River; however, these surveys did not detect Cutlip Minnow (Barnucz and Reid, in draft). The Fish Identification Nearshore Survey project carried out between 2015 and 2021 by the St. Lawrence River Institute of Environmental Sciences and the Mohawk Council of Akwesasne contributed to a more accurate description of the species' range in the Ontario portion of the St. Lawrence River (figure 5, inset B). This project also led to new detections near Macdonell Island. In 2013, COSEWIC identified that the species had disappeared from 2 areas in Ontario, the Delisle River and the St. Lawrence River at Ivy Lea.

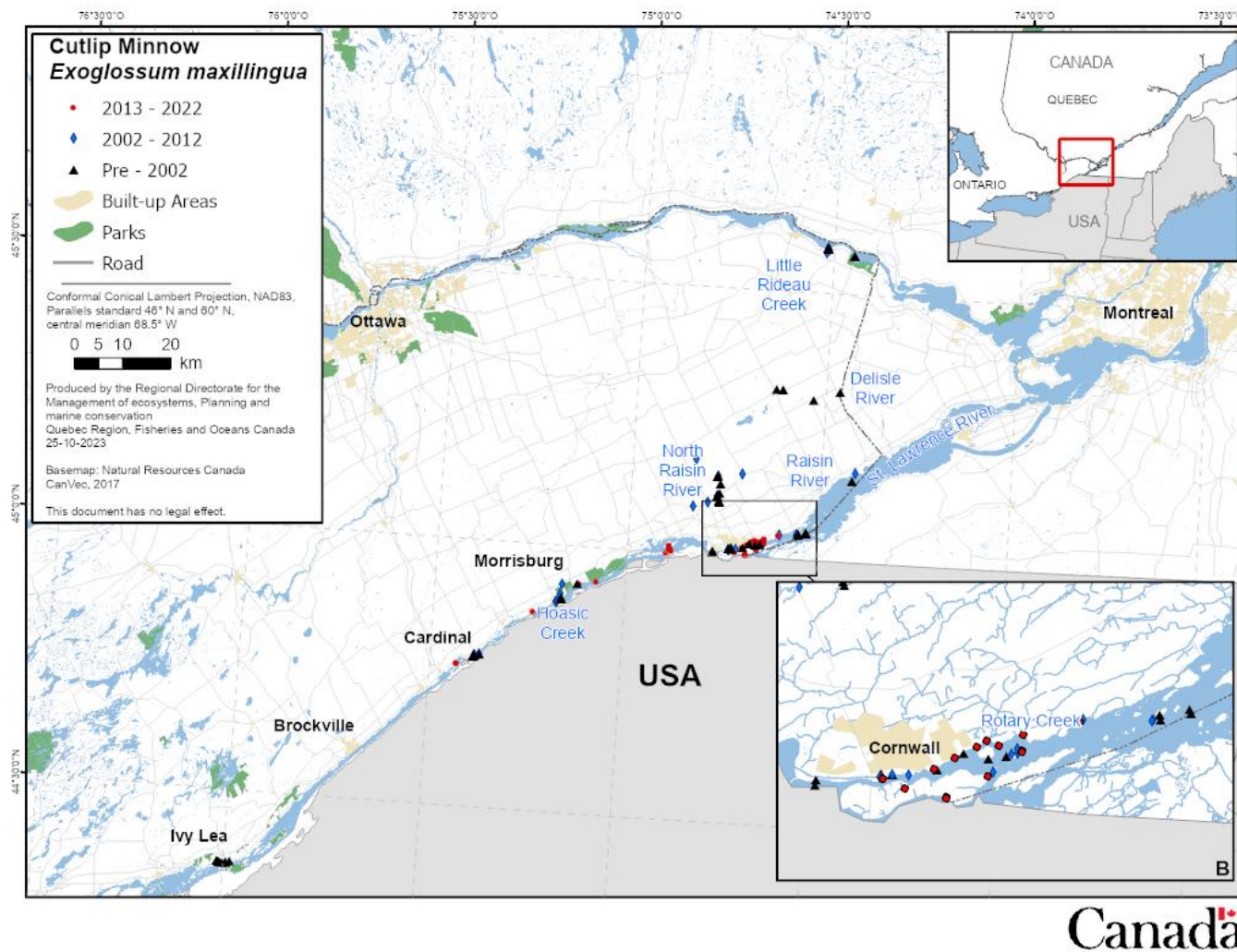


Figure 5. Distribution of the Cutlip Minnow in Ontario, based on data from the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and the Ontario Ministry of Natural Resources (OMNR) Natural Heritage Information Centre.

4.2.3 Canadian population size, status and trends

In Canada, COSEWIC designated the Cutlip Minnow a species of special concern in 2013 and it was listed as such in Schedule 1 of SARA in 2019. In Ontario, the species is listed as threatened under the province's *Endangered Species Act, 2007*; however, it has no specific protected status in Quebec. Current trends in Canadian populations are difficult to quantify since many locations with historical records have not been sampled on an ongoing basis. There are no abundance estimates for Canadian populations.

Quebec – Population trends in Quebec are difficult to assess since surveys have been carried out by different groups and many surveys did not involve repeat monitoring. In addition, records of failed collection attempts are not available for all the sampling sites. The increase in the number of detections and waterbodies containing the Cutlip Minnow is likely attributable to increased sampling efforts rather than an actual range expansion. The lack of monitoring in some areas does not allow for the determination of whether populations have persisted or are extirpated. Updating the historical records will make it possible to determine if the extent of occurrence, as defined by COSEWIC, has actually decreased or if this is an artefact of insufficient sampling.

There are several watersheds in Quebec where Cutlip Minnow was detected historically but not in recent years (appendix A). For example, surveys targeting Cutlip Minnows in the Bayonne and la Chaloupe river watersheds by electrofishing and seine in 2021 were unsuccessful at capturing Cutlip Minnow, and historical records from 1971 could not be confirmed and updated (Consortium Groupe Hémisphères and Enviro Science et Faune Inc., 2022). The species was not collected in the Raquette and Beaudette rivers during a survey targeting cyprinids and small percids at risk with beach seine on the Vaudreuil-Soulanges peninsula in 2021, although it was present in the 2 rivers in 1964 and 1971, respectively (Écogénie Inc. 2022a). The species may be extirpated from these watercourses, but more inventories would be required to confirm. In addition, no individuals have been recorded in the last 20 years in the du Chêne, Kamouraska, Port-Joli, Portneuf, Saint-Charles, and Yamaska river watersheds. Furthermore, the species' presence has not been detected since 2003 in the St. Lawrence River between Lake St. Francis and south of Boucherville islands (figure 4, inset A). Lastly, several other rivers with historical records must be sampled to confirm which waterbodies still contain the Cutlip Minnow and how much the extent of occurrence might have changed. The lack of sampling and population monitoring makes it difficult to confirm the status of Cutlip Minnow populations in these watercourses.

Ontario – It is possible to assess Cutlip Minnow population trends in Ontario, since data on failed collection attempts are available. Based on these data, the area of occupancy in Ontario seems to have declined by 20% since 1991 (COSEWIC 2013). The species has apparently been extirpated from 2 sites in the last 10 years, in the Delisle River and in the St. Lawrence River near Ivy Lea. Six sampling campaigns targeting the Cutlip Minnow were conducted in the Ontario portion of the Delisle River between 1946 and 2010, but no captures of the species were recorded (MacVeigh 2013). However, sampling by the firm Écogénie Inc. in 2021 led to the collection of one individual in the Quebec portion of the river, near the Ontario border (Écogénie Inc. 2022a). At the Ivy Lea site, the species has not been observed for nearly 3 decades. In 1943, bait dealers considered it to be common in this area (Toner 1943). The last time Cutlip Minnow was detected at the site was in 1994 (appendix B) (COSEWIC 2013). The

Ivy Lea site has only been surveyed once since 1994, therefore further surveys are needed to confirm if the species is extirpated from this location.

The South Nation Conservation Authority confirmed that the population in Nash Creek (known as Hoasic Creek) was still present in 2008, despite unsuccessful sampling efforts in 1967, 1989 and 2004 (MacVeigh 2013).

In the last decade, new records of the species have been obtained in the St. Lawrence River around Cornwall Island and near Macdonell Island (figure 5, inset B). According to a study by MacKenzie and Hickey (2010), although the Cutlip Minnow was present at a number of sites in the St. Lawrence River, it was never collected in large numbers, with often only one specimen obtained per site.

4.3 Needs of the Cutlip Minnow

4.3.1 Habitat and biological needs

From spawning to hatching: To build the nest, male spawners, which arrive on the spawning grounds before the females, choose a site with a firm bottom, consisting of gravel, rubble and cobble (Lane et al. 1996). Nests are often located near large, flat rocks or submerged logs, which offer protection and shelter during nest building and spawning (Van Duzer 1939; Scott and Crossman 1974). Spawning habitats studied by Van Duzer (1939) in central New York State had a thin layer of sediment and algae and were located at depths between 0.3 and 0.9 m. The current at the site must be strong enough to provide a constant flow of water and prevent excessive siltation, but gentle enough to prevent the removal of stones as small as 6 cm (Van Duzer 1939; COSEWIC 2013). Rotary Creek, which supports the largest population of spawning-age Cutlip Minnow in Ontario, has flow velocities of 0.3 to 0.5 m/s over the spawning grounds (Bramburger et al. 2018). To build the nest, males carry pieces of gravel one by one in their mouth, preferring those that are red or orange in colour (Bramburger et al. 2018). They pile the gravel in a relatively flat mound with a diameter of 30.5 to 46 cm and a height of 7.6 to 16.5 cm (Van Duzer 1939; Scott and Crossman 1974). The mound slows down the current upstream of the nest; its gentle slope helps retain the eggs as they are being laid (Maurakis et al. 1991). Males spend a great deal of time reworking their nests and cleaning away debris and sediment deposits (Van Duzer 1939; Bramburger et al. 2018). The larvae stay within the nest for roughly 6 days while feeding on the yolk sac, which will be completely absorbed within 3 to 8 days after hatching (Van Duzer 1939; Fuiman and Loos 1978).

Adults: In Canada, the Cutlip Minnow is found in rivers and streams with clear to clear-brown water and a gentle to moderately swift current. The species prefers warm water and has been found at temperatures as high as 32°C (Couillard et al. 2018). Streams are usually small, but can range from 1 to 20 m wide. Although it occurs more often in small rivers and creeks, the species has also been collected in the St. Lawrence River and its lake-like expansions (fluvial lakes), including Lake St. Francis and Lake Saint-Louis. The species is also known from lakes at elevations of up to 400 m in the Laurentian Mountains in Quebec (Crossman and Holm 1996; DFO 2023). The Cutlip Minnow typically occurs in streams containing rocky substrates, often with a mixture of cobbles, gravel, sand and mud, and containing relatively few aquatic plants (Scott and Crossman 1974; Bernatchez and Giroux 2012). Recent studies examining the habitat preferences of Cutlip Minnow show that the species tends to occur at sites with low to medium percentage of algae and aquatic plants coverage as well as sites that have coarse substrates with a higher proportion of boulders (Goulet et al. 2019a, 2019b, 2021; Consortium Groupe Hémisphères and Enviro Science et Faune Inc. 2022; Fisheries and Oceans Canada [DFO]

2023n). However, in the Laurentians, sites with Cutlip Minnow were more sandy (DFO 2023). In the Mauricie and Lanaudière regions, the species has been found in sections of streams that are generally less than 0.6 m deep, with clear water and a swift flow regime (for example, riffles and rapids) (Consortium Groupe Hémisphères and Enviro Science et Faune Inc. 2022). These stretches often have a substrate of bare rock, which is a characteristic of the species' preferred habitat. In the Raisin River watershed in Ontario, sites containing the Cutlip Minnow have a combination of riffles and pools and a clean stony substrate with no sediment deposition (Jacobs 2011). Similar habitat is found in Little Rideau Creek.

The Cutlip Minnow is a diurnal feeder, subsisting on aquatic benthic invertebrates, mainly chironomid and trichopteran larvae (Pappantoniou et al. 1984a, 1984b; Johnson 2015). A study in the Delaware River in Pennsylvania showed that the Cutlip Minnow's diet reflects seasonal variations in the benthos (Haase and Haase 1975). In September, when chironomid and trichopteran populations are less abundant, individuals consume more molluscs. The species is also known to attack the eyes of other fish species, particularly when Cutlip Minnow densities are high, hence its vernacular name "eye-picker."

Few studies have examined overwintering in the species, although Van Duzer (1939) observed that, in winter, Cutlip Minnow hide in groups under large flat rocks. MacKenzie and Hickey (2010) observed that the species was abundant during summer surveys in Rotary Creek, but was absent during the month of November, suggesting that it undertakes seasonal movements between different habitats.

4.3.2 Limiting factors

Although little is known about the Cutlip Minnow's physiology, temperature is probably an important limiting factor. Pappantoniou et al. (1984b) noted that, in general, individuals in New York State were longer lived and more robust than those in Pennsylvania, likely because of the more favourable climate in southeastern New York State. The harsher climatic conditions may adversely affect the lifespan of individuals in Canadian populations. The species' preference for warm water may limit its northward dispersal.

The Common Shiner (*Luxilus cornutus*), a native species, is probably another natural limiting factor for the Cutlip Minnow (Scott and Crossman 1974). This leuciscid, often found at the same sites as the Cutlip Minnow (Van Duzer 1939; Goulet et al. 2019a, 2019b, 2021; DFO 2023) may compete with the latter during spawning. Common Shiner have been observed trying to take over Cutlip Minnow nests to spawn while attempts by Cutlip Minnow to deter them were unsuccessful (Van Duzer 1939; Miller 1964).

5 Threats

5.1 Threat assessment

A threat assessment and the establishment of priority threats to the Cutlip Minnow were undertaken based on the International Union for the Conservation of Nature / Conservation Measures Partnership (IUCN-CMP) unified threats classification system. The threat classification was also adapted to comply with MELCCFP's standardized classification of threats to biodiversity document (MELCCFP 2021a). A threat is defined as any human activity or process that has caused, is causing, or may cause harm, death, or behavioural changes to a wildlife species at risk, or the destruction, degradation and/or impairment of its habitat, to the extent that population-level effects occur (DFO 2014). The threat classification table does not

take limiting factors into account, which are defined as non-anthropogenic factors that, within a range of natural variation, limit the abundance and distribution of a wildlife species or a population (DFO 2014), such as problematic native species in their natural state for species at risk. For more details on the threat assessment process, refer to the [Guidance on Assessing Threats, Ecological Risk and Ecological Impacts for Species at Risk](#). The specific assessment categories and associated rankings used for threat assessment (see table 2) are provided in appendix C. Assessment category definitions are provided in the table's footnotes.

The 5 categories of threats faced by the Cutlip Minnow are residential and commercial development; biological resource use; invasive and other problematic species, genes and diseases; pollution; and climate change and severe weather. To provide more detail, these categories are subdivided into more specific threats. Lastly, it should be noted that knowledge gaps related to the species limit the threat assessment and that threats were assessed based on the information available.

Table 2. Population-level threat assessment for the Cutlip Minnow⁴.

Threat category	Threat	Likelihood of occurrence ⁵	Level of impact ⁶	Causal certainty ⁷	Population-level threat risk ⁸	Population-level threat occurrence ⁹	Population-level threat frequency ¹⁰	Population-level threat extent ¹¹
Residential and commercial development	Housing and urban areas	Known or very likely to occur	Unknown	Low	Unknown	Unknown	Continuous	Unknown
Biological resource use	Fishing and harvesting aquatic resources	Remote	Low	Medium	Low	Historical and current	Recurrent	Restricted
Invasive and other problematic species, genes and diseases	Invasive alien plants and animals	Known or very likely to occur	Medium to high	Low	Medium to high	Current and anticipatory	Continuous	Narrow
Pollution	Domestic and urban waste water	Known or very likely to occur	High	Low	Low	Current	Continuous	Restricted

⁴ See appendix C for more details on threat assessment categories.

⁵ Likelihood of occurrence: the probability of a specific threat occurring for a given population over 10 years or 3 generations, whichever is shorter.

⁶ Level of impact: the magnitude of the impact caused by a given threat, and the level to which it affects the conservation or management of the population.

⁷ Causal certainty: the strength of evidence linking the threat to the conservation or management of the population.

⁸ Population-level threat risk: the product of likelihood and level of impact as determined using a risk matrix approach.

⁹ Population-level threat occurrence: the timing of occurrence of the threat and describes whether a threat is historical, current and/or anticipatory.

¹⁰ Population-level threat frequency: the temporal extent of the threat over the next 10 years or 3 generations, whichever is shorter.

¹¹ Population-level threat extent: the proportion of the population affected by the threat.

Threat category	Threat	Likelihood of occurrence ⁵	Level of impact ⁶	Causal certainty ⁷	Population-level threat risk ⁸	Population-level threat occurrence ⁹	Population-level threat frequency ¹⁰	Population-level threat extent ¹¹
Pollution	Agricultural and forestry effluents	Known or very likely to occur	High	Low	High	Current	Recurrent	Broad
Climate change and severe weather	Changes in precipitation and hydrological regimes	Likely to occur	Low to medium	Very low	Low to medium	Current and anticipatory	Continuous	Restricted

5.2 Description of threats

Housing and urban areas (IUCN-CMP threat 1.1)

Urbanization, industrialization and real estate development have caused major changes in the St. Lawrence River and other watercourses in the urban environment where the Cutlip Minnow occurs. Development-related activities such as filling, draining, land clearing, the use of riprap on shorelines, and the construction and use of infrastructure contribute to the loss and degradation of riparian and aquatic habitats. Surveys of the shoreline of the St. Lawrence River between Cornwall and Île d'Orléans by Lehoux (1996) showed that 45% of the banks consisted of retaining walls or riprap. The destruction and alteration of riparian zones associated with urban development are known to have long-term impacts on fish habitat (Association des gestionnaires régionaux des cours d'eau du Québec [Association of Regional Watercourse Managers of Quebec] [AGRCQ] 2017). For example, the lack of riparian buffer or the loss of vegetation in the riparian zone decreases the ability of the riparian strip to trap particles and stabilize the bank. This loss of vegetation generally leads to an increase in water temperature. Urbanization can also result in hydrological and geomorphological changes to watercourses with altered shorelines by exacerbating bank erosion, altering the morphology of the watercourse and modifying the particle size distribution of the streambed (Rivard 2011).

The frequency of capture of the Cutlip Minnow in the waterbodies sampled by Kemp and Spotila (1997) in Pennsylvania was lower at urbanized sites than in nonurbanized ones, which may suggest that urban activities adversely affect the species. Inventories are required in the St. Lawrence River between Lake St. Francis and the southern end of the Boucherville islands, one of the most urbanized areas in the species' range, as it has not been detected there for over 20 years. Surveys with seine in 2023 targeting Cutlip Minnow in lakes St. Francis and Saint-Louis failed to capture the species in this sector. Lastly, the hydrological and geomorphological changes associated with stream alteration have an impact on the availability of habitats required by the Cutlip Minnow to complete its life cycle, particularly in the species' spawning grounds where sediment size and current velocity are important characteristics in nest construction. The direct impacts of this threat on the Cutlip Minnow are difficult to quantify.

Fishing and harvesting aquatic resources (IUCN-CMP threat 5.4)

Although harvesting the Cutlip Minnow is prohibited in Canada (Ontario Ministry of Natural Resources [OMNR] 2021; MELCCFP 2021b), the species may be caught incidentally by bait fishers. Since April 1, 2017, Quebec regulations have restricted the practice of bait fishing, which reduces the risk of bycatch. Similar regulations do not exist in Ontario; however, Drake and Mandrak (2014a) estimated that there is low likelihood of Cutlip Minnow being incidentally captured through commercial fisheries, including the harvest of bait fish, and they did not detect any Cutlip Minnow during surveys of retail bait tanks and angler purchases (2014b).

Invasive alien plants and animals (IUCN-CMP threat 8.1)

Aquatic invasive species may be detrimental to species at risk in several different ways, notably by competing for habitat and food, disturbing trophic dynamics and/or through predation. According to the Working Group on the State of the St. Lawrence Monitoring (2019), the status of the St. Lawrence River with respect to the introduction of various aquatic invasive species is considered "moderate-poor." Although the impacts of aquatic invasive species on the

Cutlip Minnow are still unknown, information on some of these species is presented in this document due to their devastating impacts on aquatic communities in general.

The Round Goby (*Neogobius melanostomus*), which occurs in the St. Lawrence River, is known to compete with small benthic fishes (Morissette et al. 2018). Round Goby can compete with other fish species for food resources, interfere with spawning, displace native species so that they are forced to occupy suboptimal habitats, and prey on the young life stages of some species (Chotkowski and Mardsen 1999; French and Jude 2001; Janssen and Jude 2001; Zuwerink et al. 2019). In the Great Lakes, the Round Goby has caused the local extirpation or decline of some small native benthic fish species, such as the Mottled Sculpin (*Cottus bairdii*), Johnny Darter (*Etheostoma nigrum*) and Logperch (*Percina caprodes*) (Janssen and Jude 2001; Lauer et al. 2004; Balshine et al. 2005). The Round Goby index, calculated using its frequency of occurrence at stations sampled by the Réseau de suivi ichtyologique [fish monitoring network] (RSI) in the St. Lawrence, increased from 0% for the 1995 to 1997 period to 56% for the 2012 to 2016 period (Working Group on the State of the St. Lawrence Monitoring 2019). In Ontario, the Round Goby has been detected in the Raisin River and in the St. Lawrence River near Ivy Lea, where the Cutlip Minnow has also been recorded. Cutlip Minnow that occurs upstream of dams might be protected from this aquatic invasive species, since such infrastructure can limit the natural dispersal of Round Goby (Kornis et al. 2012); however, Round Goby have been introduced into several reservoirs in Ontario (for example, Belwood Lake). More information on the ecology and biology of the Round Goby is needed to better understand its impacts on the Cutlip Minnow.

The Rudd (*Scardinius erythrophthalmus*), a benthic cyprinid present in Lake Saint-Pierre and the Richelieu River (MELCCFP 2016; Deschenes et al. 2017), is known to compete with native fishes for invertebrate food resources (Cadwallader et al. 1977; Hicks 2003; Nico et al. 2021). The impacts of this fish on Leuciscidae could also be investigated.

Invasive plant species have also been introduced in the Cutlip Minnow's range, threatening the integrity of aquatic ecosystems (Schultz and Dibble 2012). For example, the European Water Chestnut (*Trapa natans*) has been identified as the invasive plant species that poses the greatest risk to shallow waterbodies in southern Quebec (MELCCFP 2020), and the Eurasian Water Milfoil (*Myriophyllum spicatum*) is an invasive plant species that is already found in waterbodies where Cutlip Minnow occurs (MELCCFP 2022a; MELCCFP 2022b). The spread of these species could alter trophic dynamics and the diets of fish species, create anoxic zones that cause the displacement of benthic and demersal communities, and reduce the food sources of some macroinvertebrates (Caraco and Cole 2002; Schultz and Dibble 2012).

Starry Stonewort (*Nitellopsis obtusa*) is another invasive plant species that has been detected in the Upper St. Lawrence River (Geis et al. 1981) and has continued to spread (Kipp et al. 2020), particularly in lowland freshwater lakes and in the St. Francis river basin. It forms large monoculture mats and alters water chemistry, which could limit the availability of benthic nutrients to other native species (Larkin et al. 2018). Dense mats of *N. obtusa* also limit the habitat used by native fish for spawning. Although there are no studies describing the impacts of these species on the Cutlip Minnow, invasive plants remain an important element that must be taken into account in assessing the quality of Cutlip Minnow habitats. Further research is required to better understand the potential threat that invasive plants pose to Leuciscidae.

Domestic and urban waste water / agricultural and forestry effluents (IUCN-CMP threat 9.1 & 9.3)

Point and non-point sources of pollution associated with urbanization, logging and agriculture can alter water quality and degrade aquatic habitats. Sediments, de-icing salts and sand, pharmaceuticals, heavy metals, fecal coliforms and pesticides can make their way into receiving waterbodies (Harrod and Theurer 2002; St-Hilaire et al. 2016). These contaminants are transported in runoff or spills, or by ineffective wastewater treatment and septic systems.

Some agricultural practices such as intensive drainage and bare soil practices contribute to soil erosion and the sedimentation of watercourses (Harrod and Theurer 2002). Once sediments have entered the water, they can harm aquatic ecosystems by reducing visibility and oxygen concentrations, plugging substrates, disrupting egg and larval development, altering the food chain and promoting the transport of pollutants and nutrients (Wood and Armitage 1997; Harrod and Theurer 2002). Furthermore, nitrogen and phosphorous, found in urban and agricultural effluents, stimulate algal growth. Ultimately, algal blooms in the water column increase turbidity, reduce the amount of oxygen available to aquatic fauna and alter the overall habitat quality in watercourses (Alexander et al. 2017). Toxic discharges may also affect fish communities by reducing resistance to pathogens and disrupting spawning, behaviour and embryonic development (Benoit et al. 1976; Collier et al. 1998; Hopkins et al. 2000; Hopkins et al. 2003).

The degradation of habitat quality due to agricultural and urban activities is of particular concern for this species at risk. In Quebec, agricultural activities have intensified since 1950 (Domon and Ruiz 2010) causing increased stress on aquatic environments. A large proportion of the Cutlip Minnow's range is in the St. Lawrence Lowlands, a region with extensive agricultural land use. In the Lanaudière region, the Bayonne and la Chaloupe rivers, in which the species appears to have been extirpated (Consortium Groupe Hémisphères and Enviro Science et Faune Inc. 2022), face threats from non-point and point-source agricultural pollution (MELCCFP, n. d.). The St. Lawrence River is affected by the release of contaminants from industry, particularly around Montreal. Although few surveys targeting the species have been carried out in this area, it has not been detected for over 20 years in the portion of the river between Lake St. Francis and the southern end of Boucherville islands, which is highly urbanized. In Ontario, watercourses in the Lake St. Francis watershed have been channelized to drain the land for crop production or livestock rearing and have high loads of pesticides, nutrients, and suspended sediments (COSEWIC 2013). In short, many waterbodies used by the Cutlip Minnow receive effluents from anthropogenic activities, which are detrimental to the quality of the species' habitats.

The Cutlip Minnow could be particularly susceptible to sediment inputs into watercourses. This benthic species is a visual predator that seems to prefer certain colours of gravel to build its nest; therefore, the loss of visibility from a high sediment load may be detrimental to the Cutlip Minnow, particularly during periods of spawning and feeding. Sediment inputs may also lead to the Cutlip Minnow expending more energy to maintain its nest instead of engaging in other vital functions, since the species has been observed cleaning sediments from its nest. Finally, siltation-related pollution is known to disrupt benthic invertebrate communities (Wood and Armitage 1997). Increased exposure to pollution may result in significant changes to the food web in aquatic communities, thus affecting the availability of the Cutlip Minnow's prey.

Changes in precipitation and hydrological regimes (IUCN-CMP threat 11.4)

Global climate change is expected to have significant effects on aquatic ecosystems in the St. Lawrence River watershed. In general, increasing temperatures, decreasing water levels in rivers of southern Quebec and the expansion of certain invasive plants threaten the quality and

availability of aquatic habitats (Ouranos 2015). Due to climate change, many regions of Quebec can expect more precipitation that could have serious impacts on the environment, including increased erosion. Climate change can also impact on the physico-chemical properties of water and disrupt the life cycles of fish (Ouranos 2015). Water quality could be adversely affected by predicted reductions in flow rates during low-flow periods that could limit the dilution capacity of streams, changes in the frequency of intense precipitation or flood events, and increasing water temperatures (Ouranos 2015). Global warming can also promote the establishment and spread of potentially harmful aquatic invasive species by removing barriers to survival related to water temperature. For example, climate warming could favour the dispersal of the Rudd in the rivers north of the St. Lawrence River (MELCCFP 2016).

Higher precipitation rates increase the risk of flooding, which may cause mortality in the Cutlip Minnow if eggs and fry are swept downstream far from the nest. Heavy flooding is thought to have caused the smaller 1972 year class in the Delaware River in eastern Pennsylvania (COSEWIC 2013). Despite the impacts of altered precipitation regimes resulting from climate change, the Cutlip Minnow could also benefit from the increased water temperatures and expand its range northward, although salinity or impassable barriers may limit this migration.

6 Management objectives

Management objectives establish, to the extent possible, the number of individuals and/or populations, and their geographic distribution, that are necessary to prevent the species from becoming endangered or threatened. However, insufficient information is available on the abundance of current populations to develop scientifically defensible quantitative targets for the Cutlip Minnow. Accordingly, the following qualitative management objectives have been developed for the Cutlip Minnow:

- I. identify, monitor and reduce the threats posed by widespread habitat degradation and invasive species
- II. determine the distribution of extant populations
- III. improve knowledge of the species' biological, ecological and habitat requirements
- IV. increase awareness of the Cutlip Minnow and promote public engagement in the conservation of the species
- V. maintain, in the long term, self-sustaining populations throughout the current range of the Cutlip Minnow to ensure the species' viability in the wild

7 Broad strategies and measures for the conservation of the species

This management plan includes 4 broad strategies and related measures for the conservation of the species in order to prevent the Cutlip Minnow from becoming threatened or endangered.

Section 7.1 provides an overview of the actions already completed or underway for the conservation of the species. Section 7.2 identifies broad strategies for the conservation of the Cutlip Minnow. The conservation measures to be implemented are summarized in an implementation schedule (tables 3, 4 and 5) in section 7.3, which prioritizes actions and identifies

leads, partners and timelines. Section 7.4 contains additional information on the conservation measures listed in the implementation schedule.

7.1 Actions already completed or currently underway

Several recovery strategies, action plans and management plans have already been prepared for aquatic species at risk that occur in the watersheds occupied by the Cutlip Minnow. The measures recommended in these documents are expected to also benefit the Cutlip Minnow.

Ecosystem-based action plans for watersheds occupied by Cutlip Minnow include the following:

- [Multi-species Action Plan for the Richelieu River Watershed in Canada \(2025\)](#)
- [Multi-species Action Plan for La Mauricie National Park and National Historic Sites of La Mauricie and Western Quebec regions \(2022\)](#)
- [Multi-species Action Plan for Thousand Islands National Park \(2015\)](#)

DFO and other provincial and federal ministries have developed or are developing recovery documents for a variety of fish and mussel species at risk, the distributions of which partly overlap with Cutlip Minnow. DFO, other jurisdictions, organizations and/or individuals are currently engaged in the implementation of recovery actions and conservation measures for the following aquatic species that will also benefit the Cutlip Minnow¹²:

- Bridle Shiner (*Notropis bifrenatus*)
- Northern Brook Lamprey (*Ichthyomyzon fossor*), Great Lakes – Upper St. Lawrence populations
- Channel Darter (*Percina copelandi*)
- Copper Redhorse (*Moxostoma hubbsi*)
- Eastern Sand Darter (*Ammocrypta pellucida*)
- Grass Pickerel (*Esox americanus vermiculatus*)
- Hickorynut (*Obovaria olivaria*)
- Northern Sunfish (*Lepomis peltastes*), Great Lakes – Upper St. Lawrence populations
- Pugnose Shiner (*Notropis anogenus*)
- Rainbow Smelt (*Osmerus mordax*), Southern St. Lawrence Estuary population
- River Redhorse (*Moxostoma carinatum*)
- Silver Lamprey (*Ichthyomyzon unicuspis*), Great Lakes – Upper St. Lawrence populations
- Striped Bass (*Morone saxatilis*), St. Lawrence River Population

The Government of Canada has provided funding to support the implementation of recovery and management measures for species at risk under various programs. The funding awarded

¹² This is not necessarily a complete list of all the aquatic species at risk for which recovery actions and conservation measures might also benefit the Cutlip Minnow.

under these programs has supported a number of projects focused on education, outreach, monitoring, research or stewardship for species at risk.

The following paragraphs summarize some of the conservation initiatives that have been completed or are currently underway by DFO or its partners.

In Quebec, the Cyprinids and Small Percids Recovery Team is responsible for coordinating the recovery of small freshwater fish species that have been, or are likely to be, designated under the *Act Respecting Threatened or Vulnerable Species (1989)*. Although the Cutlip Minnow does not have protected status at the provincial level, it is included in the team's recovery activities, both in the synthesis and dissemination of new scientific information and in the planning and coordination of projects to assist in the species' recovery.

DFO has funded projects targeting the Cutlip Minnow to obtain a better understanding of the species' current distribution and improve knowledge of the species' habitat requirements. Between 2018 and 2020, MELCCFP directed efforts in the Estrie region (Eastern Townships) to conduct fish surveys in areas where the Cutlip Minnow was potentially present and, when the species was found, to characterize its habitat (Goulet 2019a, 2019b, 2021). Sampling was performed in the summer of 2021 to confirm the species' presence in 5 rivers where historical records had been obtained (Bayonne, la Chaloupe, Chicot, Maskinongé and Yamachiche), and to characterize the habitat and identify threats in the areas where the presence of aquatic species at risk was confirmed (Consortium Groupe Hémisphères and Enviro Science et Faune Inc. 2022). According to the latter study, the species was not found in the Bayonne and la Chaloupe rivers, which had the highest turbidity of all the watercourses sampled. In addition, illegal water removals from la Chaloupe River by farming enterprises (Blouin 2020) have been identified as a potential threat to the Cutlip Minnow (Consortium Groupe Hémisphères and Enviro Science et Faune Inc. 2022). In 2021, the firm Écogénie Inc. was commissioned to conduct fish surveys on the Vaudreuil-Soulanges peninsula to validate the presence of cyprinids and small percids at risk, including the Cutlip Minnow, in suitable areas and to characterize the habitat at the stations surveyed (Écogénie Inc. 2022a). The species was collected in the Delisle and Rigaud rivers during these surveys. Cutlip Minnow were captured in 2022 near the historical capture sites in du Nord, du Diable and à Simon rivers as well as in lake Saint-Denis (DFO 2023). During these activities, a sampling protocol for Cutlip Minnow based on environmental DNA (eDNA) was tested. Complementing this project, DFO conducted Cutlip Minnow surveys in lakes St. Francis and Saint-Louis, as well as in the Ottawa and Richelieu rivers south of the Chambly dam. Although no Cutlip Minnow were caught, eDNA samples were collected and may be analyzed in the future (DFO 2023). DFO researchers are collaborating with the National Institute of Scientific Research [Institut national de la recherche scientifique] to develop and validate an eDNA detection kit for Cutlip Minnow. The mitogenomes of Cutlip Minnow and its sympatric species will be sequenced from samples provided by DFO or other partners. These sequences will be used to obtain specific primers for the species. Overall, these surveys have contributed to an improved understanding of the species' distribution within its historical range and in new areas with a strong probability of occurrence, the species' ecology and the threats it faces.

DFO is overseeing several projects relating to aquatic invasive species that potentially pose a threat to the Cutlip Minnow in Quebec. For example, a research project on trophic interactions between the Round Goby and 2 small percid species that are at risk, the Eastern Sand Darter and Channel Darter, was launched in 2022 in the **Yamaska**, **Nicolet** and **Saint-François** rivers. In 2020, a meta-analysis of freshwater macrophytes (including invasive plant species) in Canada and their effects on aquatic ecosystems was initiated. These studies will make it possible to

better understand the impacts of aquatic invasive species on aquatic ecosystems in Quebec and Ontario. Lastly, in 2015, the Government of Canada enacted the *Aquatic Invasive Species Regulations*, which provide a series of regulatory tools under the federal government's *Fisheries Act* to prevent new introductions of aquatic invasive species and to limit their spread, complementing existing federal and provincial legislation.

In 2021, DFO also launched a collaborative project to compile the existing information on occurrences of species at risk, including the Cutlip Minnow, on the Quebec side of the Ottawa River watershed. The goal of the project is to obtain a comprehensive and representative picture of the data available for the region, in order to identify knowledge gaps related to certain areas or species in the watershed. Furthermore, the Richelieu River, located within the [St. Lawrence Lowlands Priority Place](#), supports an exceptional species richness that includes a number of species at risk, including the Cutlip Minnow. DFO has developed an action plan for the Richelieu River to better protect the environment and the species inhabiting it (DFO 2025).

In Ontario, the Cutlip Minnow is designated threatened under the province's *Endangered Species Act, 2007* (ESA) and a provincial recovery strategy was published for the species in 2013 (MacVeigh 2013). Among the 29 recovery measures proposed in this strategy, a number have been implemented since the document's publication (OMECP 2019). The Ontario government's Species at Risk Stewardship Program funded 14 projects carried out by the St. Lawrence River Institute of Environmental Sciences, the Raisin Region Conservation Authority, the South Nation Conservation Authority and the Toronto Zoo. These projects have led to the characterization of the species' habitat, improved knowledge of its distribution and abundance, a study of spawning habitat preferences, an examination of relationships between leuciscids and aquatic invasive species, outreach activities for the general public and the identification of future stewardship activities, among other achievements. For example, in 2015, the St. Lawrence River Institute of Environmental Sciences documented 2 areas suitable for the restoration of Cutlip Minnow habitat in the St. Lawrence River and developed and implemented a rehabilitation plan to restore these sites. Another project, the Fish Identification Nearshore Survey, also launched in 2015 by the River Institute, resulted in a considerable amount of information being amassed on the status of minnows and small nearshore fish communities in the Upper St. Lawrence. The project focused on habitat characteristics, aquatic invasive species, predation, water quality, and the abundance and distribution of nearshore fish species, and also led to the development of environmental indicators. It also educated volunteers, students and various partners about the importance of small fish communities in food webs, explaining why they can be good indicators of ecosystem health. Lastly, projects involving information dissemination and education campaigns increased the general public's knowledge of species at risk, including the Cutlip Minnow, and promoted the importance of protecting the health of rivers, while encouraging community participation in stewardship activities. The implementation of a multi-species, ecosystem-based outreach approach resulted in the dissemination of information about the species, its habitat or the importance to protect it to approximately 21,000 people (OMECP 2019).

To educate anglers on bait fish regulations and help them identify bait fish in Ontario, DFO and OMNR prepared the "Baitfish Primer" (DFO 2018), which includes a fact sheet on the Cutlip Minnow. The Ontario government enacted the *Invasive Species Act, 2015* to assist in the prevention, detection and control of invasive species. The Act provides a legislative framework to support the implementation of measures to reduce the threat posed by aquatic invasive species.

7.2 Broad strategies

The following broad strategies support the management objectives outlined in section 6. Broad strategies and measures for the conservation of the species are summarized and prioritized in tables 3 to 5:

1. research
2. management and coordination
3. inventory and monitoring
4. stewardship and outreach

7.3 Measures for the conservation of the species

Success in the conservation of this species is dependent on the actions of many different jurisdictions, industries, non-governmental organizations, Indigenous groups, and Canadians in general; it requires the commitment and cooperation of the constituencies that will be involved in implementing the measures set out in this management plan.

The measures set out in this management plan provide the best chance of achieving the management objectives for the Cutlip Minnow to guide not only activities to be undertaken by DFO, but those for which other jurisdictions, organizations, and individuals may have a role to play. As new information becomes available, these measures and the priority of these measures may change. DFO strongly encourages all Canadians to participate in the conservation of the Cutlip Minnow by undertaking the measures for the conservation of the species outlined in this management plan.

Table 3 identifies the measures for the conservation of the species to be undertaken by DFO to manage the conservation of the Cutlip Minnow. Table 4 identifies the measures for the conservation of the species to be undertaken collaboratively between DFO and its partners, other agencies, organizations, or individuals. Implementation of these measures will be dependent on a collaborative approach, in which DFO is a partner in conservation efforts, but cannot implement the measures for the conservation of the species alone. As all Canadians are invited to join in supporting and implementing this management plan, table 5 identifies the remaining measures for the conservation of the species that represent responsibilities and/or opportunities for other jurisdictions, organizations, or individuals to lead. If your organization is interested in participating in one of these measures, please contact the Species at Risk Management Division offices in the [Quebec Region](#) or the .

Federal funding programs for species at risk that may provide opportunities to obtain funding to carry out some of the outlined activities include the [Habitat Stewardship Program for Aquatic Species at Risk](#), the [Aboriginal Fund for Species at Risk](#) and the [Canadian Nature Fund for Aquatic Species at Risk](#).

The measures for the conservation of the species included in this management plan to be implemented by DFO will be subject to the availability of funding and other required resources. As indicated in the tables below, partnerships with specific organizations will provide expertise and capacity to carry out some of the listed measures. However, the identification of partners is intended to be advice to other jurisdictions and organizations and carrying out these actions will be subject to each group's priorities and budgetary constraints.

Table 3. Measures for the conservation of the Cutlip Minnow to be undertaken by Fisheries and Oceans Canada.

#	Measure	Broad strategy	Priority ¹³	Threat or objective addressed	Status ¹⁴ / Timeline ¹⁵
1	Encourage stakeholders, Indigenous peoples, conservation groups and property owners to undertake or participate in stewardship activities for the conservation of Cutlip Minnow and the protection of its habitat, including contributing to the implementation of best management practices. Ensure that information on funding opportunities (for example, federal and provincial funding programs) is accessible.	Stewardship and outreach	Medium	Promote public engagement	Underway Ongoing

¹³ "Priority" reflects the degree to which the measure contributes directly to the conservation of the species or is an essential precursor to a measure that contributes to the conservation of the species:

- "high" priority measures are considered likely to have an immediate and/or direct influence on the conservation of the species
- "medium" priority measures are important but considered to have an indirect or less immediate influence on the conservation of the species
- "low" priority measures are considered important contributions to the knowledge base about the species and mitigation of threats

¹⁴ "Status" of each conservation measure indicates whether the measure is already underway or initiated, or whether it is a new measure to be undertaken.

¹⁵ "Timeline" reflects the amount of time required for the measure to be completed from the time the management plan is published as final on the Species at Risk Public Registry.

Table 4. Measures for the conservation of the Cutlip Minnow to be undertaken collaboratively by Fisheries and Oceans Canada and its partners.

#	Measure	Broad strategy	Priority ¹⁶	Threat or objective addressed	Status ¹⁷ / Timeline ¹⁸	Potential partnerships
2	Investigate the impacts of residential and commercial development on Cutlip Minnow and the mechanisms by which these threats lead to effects.	Research	High	Residential and commercial development	New measure 2 to 3 years	Industry; municipalities; regional county municipality (RCM); community organizations
3	Study the impacts of aquatic invasive species on the Cutlip Minnow (for example, Round Goby, Rudd, new invasive species), notably in terms of competition for food resources, spawning sites and the occupation of space; predation; and food web disruptions and ecological disturbances likely to affect the Cutlip Minnow.	Research	Medium	Invasive alien plants and animals	Underway 2 to 3 years	Universities; Ontario Ministry of Natural Resources (OMNR); Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des

¹⁶ "Priority" reflects the degree to which the measure contributes directly to the conservation of the species or is an essential precursor to a measure that contributes to the conservation of the species:

- "high" priority measures are considered likely to have an immediate and/or direct influence on the conservation of the species
- "medium" priority measures are important but considered to have an indirect or less immediate influence on the conservation of the species
- "low" priority measures are considered important contributions to the knowledge base about the species and mitigation of threats

¹⁷ "Status" of each conservation measure indicates whether the measure is already underway or initiated, or whether it is a new measure to be undertaken.

¹⁸ "Timeline" reflects the amount of time required for the measure to be completed from the time the management plan is published as final on the Species at Risk Public Registry.

#	Measure	Broad strategy	Priority ¹⁶	Threat or objective addressed	Status ¹⁷ / Timeline ¹⁸	Potential partnerships
						Parcs (MELCCFP); community organizations
4	Address knowledge gaps in areas that currently limit conservation planning, for example, wintering areas, seasonal migrations, habitat use and habitat requirements for different stages of the life cycle.	Research	Medium	Improve knowledge	New measure 3 to 5 years	Universities; MELCCFP; OMNR; community organizations
5	Update the threat assessment as new information becomes available and share the information.	Management and coordination	Medium	All threats	Underway 1 to 2 years	Recovery teams; OMNR; MELCCFP
6	Share information on mitigation measures to reduce threats to the Cutlip Minnow with partner organizations.	Management and coordination	Medium	All threats	New measure 3 to 5 years	Recovery teams; OMNR; MELCCFP
7	Ensure that existing and future data on successful and unsuccessful attempts to collect the Cutlip Minnow using standardized methods are compiled in centralized databases to better coordinate surveys and effectively manage the species.	Management and coordination	Medium	Determine species distribution	Underway 3 to 5 years	MELCCFP; OMNR; community organizations
8	Collaborate and share information among federal and provincial governments, stakeholders, Indigenous peoples and recovery teams to improve the effectiveness of conservation measures to benefit the Cutlip Minnow.	Management and coordination	Low	All threats	Underway 3 to 5 years	Indigenous peoples; industry; municipalities; RCM; provincial departments and other federal departments;

#	Measure	Broad strategy	Priority ¹⁶	Threat or objective addressed	Status ¹⁷ / Timeline ¹⁸	Potential partnerships
						community organizations; recovery teams
9	Identify and compile a list of priority sites that could be targeted for restoration efforts to improve habitat quality for the Cutlip Minnow, and implement restoration actions at these priority sites.	Management and coordination	High	Pollution; residential and commercial development; invasive alien plants and animals	New measure 3 to 5 years	MELCCFP; recovery teams; Environment and Climate Change Canada (ECCC); community organizations
10	Conduct targeted surveys in order to update the distribution of Cutlip Minnow at historical sites and investigate the species' presence in new areas with a strong probability of occurrence, using a standardized sampling protocol.	Inventory and monitoring	Medium	Determine species distribution	Underway Ongoing	MELCCFP; OMNR; community organizations
11	Explore the possibility of developing a national or provincial monitoring program to regularly validate the presence of the species in its range, estimate population size and trends, and monitor the condition and status of the species' habitats, using a standardized sampling protocol.	Inventory and monitoring	Medium	Determine species distribution	New measure 3 to 5 years	MELCCFP; OMNR; recovery teams
12	Develop protocol for standardized estimates of relative or absolute abundance of Cutlip Minnow populations.	Inventory and monitoring	Low	Improve knowledge	New measure 1 to 2 years	MELCCFP; recovery teams; universities
13	Assess the feasibility of developing a sampling protocol for the Cutlip Minnow using environmental DNA to potentially detect the	Inventory and monitoring	Low	Determine species distribution	New measure	MELCCFP; recovery teams; universities

#	Measure	Broad strategy	Priority ¹⁶	Threat or objective addressed	Status ¹⁷ / Timeline ¹⁸	Potential partnerships
	species in new waterbodies or confirm its presence at sites with historical records.				1 to 2 years	
14	Develop educational material to raise awareness and encourage the participation and support of various stakeholders (for example, anglers, citizens' groups, and environmental organizations) in the protection of freshwater fish and the conservation of healthy aquatic ecosystems, including information on the characteristics of, and threats to, the Cutlip Minnow.	Stewardship and outreach	Low	All threats	New measure 3 to 5 years	Community organizations; MELCCFP; Ontario Federation of Anglers and Hunters (OFAH); OMNR; OMECP; recovery teams;

Table 5. Measures for the conservation of the Cutlip Minnow that represent responsibilities and/or opportunities for other jurisdictions, organizations or individuals to lead.

#	Measure	Broad strategy	Priority ¹⁹	Threat or objective addressed	Status ²⁰ / Timeline ²¹	Potential/ confirmed jurisdiction or organization
15	Implement best management practices (BMPs) for agricultural and urban effluents and erosion reduction in areas where the main threats to the species involve water quality. Examples of BMPs: use of settling basins, integration of perennial and cover crops in rotations and agricultural practices for soil conservation, optimal fertilizer management, agricultural water management structures, pesticide reduction, creation or expansion of riparian buffers.	Stewardship and outreach	High	Pollution; residential and commercial development	New measure 3 to 5 years	RCM; municipalities; community organizations; agro-environmental advisory clubs
16	Raise awareness of and encourage urban planners and municipalities to integrate conservation measures and sound development practices into land-use planning activities to minimize impacts to the Cutlip Minnow and its habitat, particularly in agricultural and urban environments.	Stewardship and outreach	Medium	Pollution; residential and commercial development	New measure 3 to 5 years	Community organizations; provincial governments; municipalities; RCM; recovery teams

¹⁹ "Priority" reflects the degree to which the measure contributes directly to the conservation of the species or is an essential precursor to a measure that contributes to the conservation of the species:

- "high" priority measures are considered likely to have an immediate and/or direct influence on the conservation of the species
- "medium" priority measures are important but considered to have an indirect or less immediate influence on the conservation of the species
- "low" priority measures are considered important contributions to the knowledge base about the species and mitigation of threats

²⁰ "Status" of each conservation measure indicates whether the measure is already underway or initiated, or whether it is a new measure to be undertaken.

²¹ "Timeline" reflects the amount of time required for the measure to be completed from the time the management plan is published as final on the Species at Risk Public Registry.

7.4 Description of measures for the conservation of the species

Broad strategy: research

Currently, knowledge gaps involving certain aspects of the biology and ecology of the Cutlip Minnow in Canada are limiting conservation planning and threat assessment for the species. Additional research is needed to determine the species' habitat requirements outside of the spawning season (that is, juvenile habitat use and over-wintering areas). Urbanization and other factors that may cause habitat degradation, as well as the impacts of aquatic invasive species, could also be investigated to inform the management of these threats to the Cutlip Minnow. Research should focus on the level of impact, threat occurrence and extent to inform future assessments of the species.

Broad strategy: management and coordination

Basic information on the biology and ecology of the Cutlip Minnow and assessments of the threats impacting the species will allow for the implementation of targeted and effective mitigation measures by organizations involved in conservation efforts. This knowledge could also inform and improve stewardship activities and help in analyzing project impacts. Moreover, a list of priority habitats should be prepared and shared with conservation and stewardship groups so that they can focus their efforts to improve water quality and better target habitat restoration efforts.

To improve the effectiveness of conservation measures, efforts must be made to promote collaboration and the sharing of knowledge and resources between partner organizations and stakeholders. For example, available information on the Cutlip Minnow should be entered into existing federal and provincial geo-referenced databases or shared among the organizations through a facilitated exchange mechanism to prioritize future research, integrate habitat information, and coordinate conservation efforts.

Broad strategy: inventory and monitoring

The known distribution of Cutlip Minnow populations may not accurately reflect the true distribution of the species due to inconsistent sampling. Occurrences over 20 years old are considered historical occurrences and cannot be used to determine the species' actual distribution with certainty. Surveys are required at the sites of known occurrences at regular intervals to prevent them from becoming historical occurrences without adequate validation. The most up-to-date lists of watercourses in which the species has been captured are presented in appendix A and B. Organizations wishing to conduct inventories are invited to consult these lists in order to plan their activities. Ideally, data should also be gathered on habitat characteristics to target new areas where there is a strong probability of finding the species.

For several years, Ontario has surveyed but not captured the species. DFO surveys in Quebec provide absence data, but the database is not complete at this time. The sharing of presence/absence data obtained in targeted Cutlip Minnow inventories is important to the management of the species; presence/absence data should be transmitted to DFO and to managers of centralized databases such as the OMNR's Natural Heritage Information Centre, the St. Lawrence Global Observatory and the Centre de données sur le patrimoine naturel du Québec [Quebec natural heritage data centre] (CDPNQ). Collaboration between the provincial and federal governments is essential to obtain an accurate and up-to-date picture of the species' distribution. The sharing and centralization of data cannot be done without the

participation of these jurisdictions. Stakeholders with data on the species' presence (ministries, industry, community organizations, etc) should also be encouraged to transmit these data to the centralized databases or to DFO. The integration and updating of species distribution information in centralized databases would also help to optimize sampling efforts, so that the same rivers and streams are not resampled unnecessarily.

A standardized national monitoring program is required to regularly validate the species' occurrence in its range, in order to assess changes and/or trends in range size, population abundance, and habitat extent and quality. Such a program would help to provide sound estimates of the size of extant populations and assist in assessing their status. The MELCCFP's Réseau de suivi ichtyologique [fish monitoring network] program monitors freshwater fish communities in the main sections of the St. Lawrence River and its fluvial lakes, the upper Richelieu River and Missisquoi Bay, using 2 types of fishing gear (gillnets and beach seines). Since there is already a well-established fish survey in the St. Lawrence River, it would be useful to take this existing monitoring program into account before developing the national monitoring program, to avoid sampling the same relevant stations. Regular surveys could help guide the updating of the threat assessment for the species.

Exploring the possibility of developing a less invasive sampling protocol using eDNA would also advance monitoring efforts. eDNA sampling is less intrusive than traditional sampling techniques such as electrofishing or other methods that require handling specimens, and is quicker and less expensive to use than other methods for confirming the presence of aquatic species at risk that occur in small numbers. Note that positive eDNA detections would always need to be validated by detections of the species through conventional sampling methods.

A standardized survey protocol was developed for small species of fish at risk in Quebec (Couillard et al. 2023). It should be provided to all conservation and stewardship groups conducting Cutlip Minnow surveys in Quebec and Ontario. Furthermore, in order to establish quantitative conservation objectives, it is necessary to develop protocols to estimate the abundance of Cutlip Minnow populations.

Broad strategy: stewardship and outreach

DFO can assist conservation and stewardship groups to develop projects that will benefit species at risk. For example, information on monetary incentives for activities benefiting the Cutlip Minnow, such as funding programs for conserving species and their habitats, can be shared with organizations likely to undertake this type of project. DFO can also share information on species at risk and direct stakeholders to appropriate action plans, recovery strategies and management plans.

It is also important to involve partners in the identification and implementation of best soil management practices that are the most effective in mitigating the degradation of water quality at Cutlip Minnow occurrence sites within agricultural and urban environments. Agronomists specializing in soils and the environment are key partners in determining the best agricultural management practices and in facilitating their implementation. In addition, farmers' organizations that use innovative practices to conserve and protect riparian and aquatic environments can play a direct and important role in addressing the threat from pollution and are important partners in species conservation.

Urban planners, municipalities and regional county municipalities (RCMs) should be made aware of the need to take species at risk such as the Cutlip Minnow into account when planning land use and development in their jurisdictions and territories. For example, the occurrences of

species at risk that face a threat from agricultural pollution could be mentioned in RCMs agricultural zone development plans to provide a more detailed picture of the territory and its biodiversity. Appendices A and B can be consulted for a list of waterbodies in which Cutlip Minnow has been detected.

Educational materials, such as pocket identification guides, interpretation and awareness panels, cellphone apps and interactive games should be developed and promoted to complement other traditional communications- and outreach-related initiatives. For example, information on other species at risk that overlap in their range with Cutlip Minnow and face the same threats, such as the Eastern Sand Darter and Channel Darter, can be combined with information on the Cutlip Minnow for dissemination purposes. Social marketing, a strategy based on the adoption of beneficial behavior, would also raise awareness of threats to several small fish species, including Cutlip Minnow. This strategy can be effective in a multi-species approach. Moreover, many innovative initiatives have already been launched by riparian owners and farmers, and it would be worthwhile promoting them to showcase the good work and progress made.

The impacts of bycatch by bait fishers could be minimized through outreach initiatives in areas where the bait fishery is allowed and where there is a concentration of habitats likely to be used by the species. It is also important to educate anglers that it is prohibited to catch the Cutlip Minnow and only certain species of baitfish are allowed to be caught. This could be done in conjunction with the issuance of fishing licences to anglers. Educational materials, such as identification guides to species at risk, could also be distributed to anglers.

8 Measuring progress

The performance indicators presented below provide a way to define and measure progress toward achieving the management objectives. The management objectives I to IV are components that will contribute towards achieving objective V, which is to maintain self-sustaining Cutlip Minnow populations throughout the species' current range and ensure the species' long-term viability in the wild. Progress towards meeting these management objectives will be reported on in the report on the progress of the management plan implementation, 5 years after the publication of the final document on the [Species at Risk Public Registry](#), and every subsequent 5 years.

The performance indicators presented below provide a way to define and measure progress toward achieving the management objectives. The performance indicators are as follows:

- surveys of the species' range indicate that the range has been maintained and data on populations and habitat have been collected to assess populations trends by 2036
- knowledge on the Cutlip Minnow's biology, ecology, habitat and the threats it faces has been improved, facilitating the species' conservation by 2031
- stewardship measures have been undertaken to mitigate the threats to the species and its habitats, and monitoring has been conducted to evaluate the efficacy of these projects by 2031
- collaborative working relations have been established and effective management practices have been developed to improve the management of the Cutlip Minnow by 2031

References

- AGRCQ - Association des gestionnaires régionaux des cours d'eau du Québec. 2017. Guide sur la gestion des cours d'eau du Québec. Granby : AGRC, 321 p.
- Alexander, T.J., P. Vonlanthen, and O. Seehausen. 2017. Does eutrophication-driven evolution change aquatic ecosystems? *Philosophical Transactions of the Royal Society B: Biological Sciences* 372(1712): 20160041.
- Auger, S. pers. comm. 2023. Équipe de rétablissement des cyprins et petits percides annual meeting. April 2023. Direction de la gestion de la faune de Lanaudière et des Laurentides. Quebec Ministry of the Environment, the Fight Against Climate Change, Wildlife and Parks (MELCCFP) [Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs].
- Balshine, S., A. Verma, V. Chant, and T. Theysmeyer. 2005. Competitive interactions between round gobies and logperch. *Journal of Great Lakes Research* 31(1):68-77.
- Barnucz, J., and S.M. Reid. 2011. Targeted sampling for Channel Darter (*Percina copelandi*) in the Lower Ottawa River (draft). Ontario, Canadian Data Report of Fisheries and Aquatic Sciences.
- Benoit, D.A., E.N. Leonard, G.M. Christensen, and J. T. Fiandt. 1976. Toxic effects of cadmium on four generations of brook trout (*Salvelinus fontinalis*). *Transactions of the American Fisheries Society* 105:550-560.
- Bernatchez, L., and M. Giroux. 2012. Les Poissons d'Eau Douce du Québec et leur Répartition dans l'Est du Canada. Saint-Constant, Quebec, Broquet, p. 138-139.
- Blouin, M. 2020. Des prélèvements illégaux dans la rivière Chaloupe ? [online], Journal l'Action, 19 August 2020 (in French only).
- Bramburger, A.J., K.E. Moir, and M.B.C. Hickey. 2018. Preferential incorporation of dark, coloured materials into nests by a mound-nesting stream cyprinid. *Journal of Fish Biology* 93(4):719-722.
- Buynak, G.L., and H.W. Mohr, Jr. 1980. Larval development of Stoneroller, Cutlips Minnow, and River Chub with diagnostic keys, including four additional cyprinids, *The Progressive Fish-Culturalist* 42(3):127-135.
- Cadwallader, P.L., G.D Coates and A.S. Turner. 1977: Introduction of rudd *Scardinius erythrophthalmus* into New Zealand. Fisheries Technical Report No. 147. New Zealand Ministry of Agriculture and Fisheries, Wellington, 24 p.
- Caraco, N. F., and Cole, J.J. 2002. Contrasting impacts of a native and alien macrophyte on dissolved oxygen in a large river. *Ecological Applications* 12(5):1496-1509.
- Carlson, D.M., R.A. Daniels, and J.J. Wright, 2016. *Atlas of Inland Fishes of New York*, published jointly by the New York State Education Department and Department of Environmental Conservation, Albany, New York, 362 p.

- CDPNQ - Centre de données sur le patrimoine naturel du Québec. 2022. Base de données sur les espèces menacées ou vulnérables du Québec. Quebec Government, Quebec Ministry of the Environment, the Fight Against Climate Change, Wildlife and Parks (MELCCFP) [Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs], Canada Government, Environment and Climate Change Canada, Canadian Wildlife Service.
- Chotkowski, M.A., and J.E. Marsden. 1999. Round goby and mottled sculpin predation on lake trout eggs and fry: field predictions from laboratory experiments. *Journal of Great Lakes Research*, 25(1), p.26-35.
- Collier, T.K., L.L. Johnson, C. M. Stehr, M.S. Myers, and J.E. Stein. 1998. A comprehensive assessment of the impacts of contaminants on fish from an urban waterway. *Marine Environmental Research* 46:243-247.
- Consortium Groupe Hémisphères and Enviro Science et Faune Inc. 2022. Inventaire de bec-de-lièvre (*Exoglossum maxillingua*) dans cinq cours d'eau des régions de Lanaudière et Mauricie. Technical report prepared for Fisheries and Oceans Canada, 31 p.
- COSEWIC. 2013. COSEWIC Assessment and Status Report on the Cutlip Minnow *Exoglossum maxillingua* au Canada. Committee on the Status of Endangered Species in Canada. Ottawa, 35 p.
- Couillard, M.-A., F. Perret, M. Lavoie and G. Canac-Marquis. 2019. Inventaire du fouille-roche gris (*Percina copelandi*) dans la rivière Etchemin 2018. Technical Report. Direction de l'expertise sur la faune aquatique, ministère des Forêts, de la Faune et des Parcs, 12 p.
- Couillard, M.-A., G. Canac-Marquis and L.E. Picard. 2023. Protocole standardisé d'inventaire pour les espèces de poissons de petite taille en situation précaire au Québec, Quebec Ministry of the Environment, the Fight Against Climate Change, Wildlife and Parks (MELCCFP) [Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs], 56 p.
- Crossman, E.J., and E. Holm. 1996. The status of the Cutlips Minnow, *Exoglossum maxillingua*, in Canada. *Canadian Field Naturalist* 110(3):470-477.
- Deschenes, V., R. Gagnon, M. Durand, and L. Monette. 2017. Analyse de la valeur écologique du Richelieu et des statuts de reconnaissance possibles. Centre d'interprétation du milieu écologique du Haut-Richelieu, Mont-Saint-Grégoire, Quebec, 61 p.
- Desroches, J. F., and I. Picard. 2017. *Poissons d'eau douce du Québec et des Maritimes*. Éditions Michel Quintin.
- Dextrase, A., and S. Reid. 2004. Sampling for Cutlip Minnow (*Exoglossum maxillingua*) in Eastern Ontario – September 22-23, 2004. Species at Risk Section, Ontario parks, p. 6.
- DFO. 2014. Guidance on assessing threats, ecological risk and ecological impacts for species at risk. Can. Sci. Advisory Secretariat, Science Advisory Report 2014/013. (Erratum: June 2016).

- DFO. 2018. The Baitfish Primer 2018: A Guide to Identifying and Protecting Ontario's Baitfishes, prepared by Becky Cudmore and Nicholas E. Mandrak. Burlington, Ontario, Fisheries and Oceans Canada, 39 p.
- DFO. 2023. Détection d'espèces aquatiques en péril à l'aide de la pêche et l'ADNe dans le bassin versant de la rivière des Outaouais en 2022. Mont-Joli (Quebec).
- DFO. 2025. Multi-species Action Plan for the Richelieu River Watershed in Canada [Final]. *Species at Risk Act* Action Plan Series. Fisheries and Oceans Canada, Ottawa, 54 p.
- Domon, G., J. Ruiz. 2010. Vers une stratégie de prise en compte du caractère multifonctionnel des paysages: défis et pistes d'interventions en zone d'intensification agricole. La multifonctionnalité de l'agriculture et des territoires ruraux under the direction of Bruno Jean and Danielle Lafontaine. Éditions du GRIDEQ et du CRDT, Rimouski (Quebec), p.177-194
- Drake, D.A.R., and N. E. Mandrak. 2014a. Harvest models and stock co-occurrence: probabilistic methods for estimating bycatch. *Fish and Fisheries* 15:23-42.
- Drake, D.A.R., and N. E. Mandrak. 2014b. Ecological risk of live bait fisheries: a new angle on selective fishing. *Fisheries*, 39:201-211.
- Écogénie Inc. 2022a. Inventaire de cyprins et petits percidés en péril en vertu de la *Loi sur les espèces en péril* dans la péninsule de Vaudreuil-Soulanges. Public Services and Procurement Canada. Final report, 20 p.
- Écogénie Inc. 2022b. Évaluation de la qualité des habitats et de la présence de dard de sable dans le bassin versant de la rivière Nicolet. Public Services and Procurement Canada. Final report, 18 p.
- Ellis, L. pers. comm. 2021. Email to A. Tétreault. November 2021. Species at Risk Branch. Ministry of the Environment, Conservation and Parks of Ontario.
- French III, J.R., and D.J. Jude. 2001. Diets and diet overlap of nonindigenous gobies and small benthic native fishes co-inhabiting the St. Clair River, Michigan. *Journal of Great Lakes Research* 27(3):300-311.
- Fuiman, L.A., and J.J. Loos. 1978. Morphological changes during the larval development of the Cutlips Minnow, *Exoglossum maxillingua*. *Transactions of the American Fisheries Society* 107(4):605-612.
- Geis, J.W., G.J. Schumacher, D.J. Raynal, and N.P. Hyduke. 1981. Distribution of *Nitellopsis obtusa* (Charophyceae, Characeae) in the St Lawrence River: a new record for North America. *Phycologia* 20:211–214.
- Goulet, M.-J., S. Cholette, and R. Houle. 2019a. Inventaire du bec-de-lièvre (*Exoglossum maxillingua*) bassin versant de la rivière Nicolet, Estrie – Technical Report 2018. Direction de la gestion de la faune de l'Estrie, de Montréal, de la Montérégie et de Laval, ministère des Forêts, de la Faune et des Parcs, 13 p.
- Goulet, M.-J., S. Cholette, and R. Houle. 2019b. Inventaire du bec-de-lièvre (*Exoglossum maxillingua*) bassin versant de la rivière Nicolet, Estrie - Rapport technique 2019. Direction

- de la gestion de la faune de l'Estrie, de Montréal, de la Montérégie et de Laval, ministère des Forêts, de la Faune et des Parcs, 45 p.
- Goulet, M.-J., S. Cholette, and R. Houle. 2021. Inventaire du bec-de-lièvre (*Exoglossum maxillingua*) bassin versant de la rivière Chaudière, Estrie - Rapport technique 2020. Direction de la gestion de la faune de l'Estrie, de Montréal, de la Montérégie et de Laval, ministère des Forêts, de la Faune et des Parcs, 30 p.
- Haase, R., and B.L. Haase. 1975. Feeding ecology of the cutlips minnow, *Exoglossum maxillingua*, in the Delaware River at Bushkill, Pennsylvania, *Proceedings of the Pennsylvania Academy of Sciences* 49:67-72.
- Harrod, T.R., and F.D. Theurer. 2002. Sediment, in Agriculture, hydrology and water quality, edited by P. M. Haygarth and S. C. Jarvis. New York, NY: CABI Publishing, p.155–170.
- Hicks, B.J. 2003. Biology and potential impacts of rudd (*Scardinius erythrophthalmus* L.) in New Zealand. Wellington, New Zealand, Department of Conservation, Science and Engineering Papers. Proceedings of a workshop hosted by Department of Conservation.
- Hogg, S. 2010. Summary of sampling of Little Rideau Creek. OMNR. Peterborough, Ontario, 3 p. Unpublished Report.
- Holm, E., N.E. Mandrak, and M.E. Burridge. 2010. The ROM field guide to freshwater fishes of Ontario. Toronto, Ontario, Royal Ontario Museum, 462 p.
- Hopkins, W.A., J. W. Snodgrass, B.P. Staub, B.P. Jackson, and J.D. Congdon. 2003. Altered swimming performance of a benthic fish (*Erimyzon sucetta*) exposed to contaminated sediments. *Archives of Environmental Contamination and Toxicology* 44:0383-0389.
- Hopkins, W.A., J.W. Snodgrass, J.H. Roe, B.P. Jackson, J.C. Gariboldi, and J.D. Congdon. 2000. Detrimental effects associated with trace element uptake in Lake Chubsuckers (*Erimyzon sucetta*) exposed to polluted sediments. *Archives of Environmental Contamination and Toxicology* 39:193-199.
- Jacobs, B. 2009. Status of the bridge shiner (*N. bifrenatus*) and cutlip minnow (*E. maxillingua*) in Cornwall Area of Concern. Raisin Region Conservation Authority. Cornwall, Ontario.
- Jacobs, B. 2010. Status of Bridge Shiner (*N. bifrenatus*), Cutlip Minnow (*E. maxillingua*), Grass Pickerel (*E. a. vermiculatus*), and River Redhorse (*M. carinatum*) in the Cornwall Area of Concern. Species at Risk Fund Final Report, Prepared by the Raisin Region Conservation Authority. Cornwall, Ontario, 41 p.
- Jacobs, B. 2011. Status of the Bridge Shiner (*N. bifrenatus*), Cutlip Minnow (*E. maxillingua*), Grass Pickerel (*E. a. vermiculatus*), River Redhorse (*M. carinatum*), and American eel (*A. rostrata*) in Cornwall Area of Concern. Raisin Region Conservation Authority. Cornwall, Ontario.
- Janssen, J., and D.J. Jude. 2001. Recruitment failure of mottled sculpin *Cottus bairdii* in Calumet Harbor, southern Lake Michigan, induced by the newly introduced round goby *Neogobius melanostomus*. *Journal of Great Lakes Research* 27(3):319-328.

- Johnson, J.H. 2015. Summer diel diet and feeding periodicity of four species of cyprinids in the Salmon River, New York. *The American Midland Naturalist* 173(2):326-334.
- Kemp, S.J., and J.R. Spotila. 1997. Effects of urbanization on brown trout, *Salmo trutta*, other fishes and macroinvertebrates in Valley Creek, Valley Forge, Pennsylvania. *American Midland Naturalist* 138(1):55-68.
- Kipp, R., and A. Ricciardi. 2012. Impacts of the Eurasian round goby (*Neogobius melanostomus*) on benthic communities in the upper St. Lawrence River. *Canadian Journal of Fisheries and Aquatic Sciences* 69(3):469-486.
- Kipp, R.M., M. McCarthy, A. Fusaro, and I.A. Pfingsten. 2020. [*Nitellopsis obtusa*](#) (Desvaux in Loiseleur) J. Groves, (1919): U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, FL, and NOAA Great Lakes Aquatic Nonindigenous Species Information System, Ann Arbor, MI, Revision Date: 1/15/2020, Peer Review Date: 11/12/2012, Access Date: 5/30/2022
- Kornis, M.S., N. Mercado-Silva, and M.J. Vander Zanden. 2012. Twenty years of invasion: a review of round goby *Neogobius melanostomus* biology, spread and ecological implications. *Journal of Fish Biology* 80(2):235-285.
- Lane, P.A., C.B. Portt, and C.K. Minns. 1996. Spawning habitat characteristics of Great Lakes fishes. Canadian Manuscript Report of Fisheries and Aquatic Sciences 2368, 48 p.
- Larkin, D.J., A.K. Monfils, A. Boissezon, R.S. Sleithd, P.M. Skawinski, C.H. Welling, B.C. Cahill, and K.G. Karol. 2018. Biology, ecology, and management of starry stonewort (*Nitellopsis obtusa*; *Characeae*): A Red-listed Eurasian green alga invasive in North America. *Aquatic Botany* 148:15-24.
- Lauer, T.E., P.J. Allen, and T.S. McComish. 2004. Changes in mottled sculpin and johnny darter trawl catches after the appearance of round gobies in the Indiana waters of Lake Michigan. *Transactions of the American Fisheries Society* 133(1):185-189.
- Lehoux, D. 1996. Restauration naturelle des rives du Saint-Laurent entre Cornwall et l'île d'Orleans : guide d'interventions. Environment and Climate Change Canada, Transport Quebec, James Bay Energy Corporation, Ducks Unlimited, Les consultants Argus inc, Quebec.
- MacKenzie, R., and M.B.C. Hickey. 2008. Status of Cutlip Minnow (*Exoglossum maxillingua*) in the St. Lawrence River. St. Lawrence River Institute for Environmental Sciences.
- MacKenzie, R., and M.B.C. Hickey. 2010. Status of Cutlip Minnow (*Exoglossum maxillingua*) in the St. Lawrence River. St. Lawrence River Institute for Environmental Sciences.
- MacVeigh, G. 2013. Recovery Strategy for the Cutlip Minnow (*Exoglossum maxillingua*) in Ontario. Ontario Recovery Strategy Series. Prepared for the Ontario Ministry of Natural Resources, Peterborough, Ontario, 31 p.
- Maurakis, E.G., W.S. Woolcott, and M.H. Sabaj. 1991. Reproductive Behavior of *Exoglossum* Species. University of Alabama. Bulletin of the Alabama Museum of Natural History 10:11-16.

- MELCCFP. 2016. [Gardon rouge ou rotengle \(*Scardinius erythrophthalmus*\)](#) [online] (in French only). Accessed November 15, 2021.
- MELCCFP. 2020. [Atlas de l'eau](#) [online], updated in October 2021 (in French only). Accessed October 19, 2022.
- MELCCFP. 2021a. Classification standardisée des menaces affectant la biodiversité – Définitions pour le Centre de données sur la conservation (CDC) du Québec v1.0, Gouvernement of Quebec, Quebec, 26 p.
- MELCCFP. 2021b. [Types of fishing and bait – Use of bait](#) [online], updated in September 2021. Accessed November 10, 2021.
- MELCCFP. 2022a. [Myriophylle à épis \(*Myriophyllum spicatum*\)](#) [online] (in French only). Accessed October 19, 2022.
- MELCCFP. 2022b. [La châtaigne d'eau \(*Trapa natans*\)](#) [online] (in French only). Accessed October 19, 2022.
- MELCCFP. N.d. [Portrait régional de l'eau Lanaudière \(Région administrative 14\)](#) [online] (in French only). Accessed October 19, 2022.
- Miller, R.J. 1964. Behavior and ecology of some North American cyprinid fishes. *American Midland Naturalist* 72:313-357.
- Morissette, O., Y. Paradis, R. Pouliot, and F. Lecomte. 2018. Spatio-temporal changes in littoral fish community structure along the St. Lawrence River (Québec, Canada) following round goby (*Neogobius melanostomus*) invasion. *Aquatic Invasions* 13(4):501-512.
- NatureServe. 2012. NatureServe explorer: An online encyclopedia of life. Version 7.1 NatureServe, Arlington, Virginia.
- Nico, L., P. Fuller, G. Jacobs, J. Larson, T.H. Makled, A. Fusaro, M. Neilson, and A. Bartos. 2021. [Scardinius erythrophthalmus - Nonindigenous Aquatic Species Database](#) [online], U.S. Geological Survey, Gainesville, Florida, updated March 8, 2021. Accessed November 22, 2021.
- OMECP. 2019. [2019 review of progress towards the protection and recovery of Ontario's species at risk – Cutlip Minnow](#) [online], updated December 10, 2019. Accessed November 22, 2021.
- OMNR. 2021. [General fishing regulations](#) [online], updated September 2, 2021. Accessed November 22, 2021.
- Ouranos. 2015. Vers l'adaptation. Synthèse des connaissances sur les changements climatiques au Québec. Edition 2015. Montreal, Quebec : Ouranos, 415 p.
- Page, L.M., and B.M. Burr. 2011. Peterson Field Guide to Freshwater Fishes of North America. North of Mexico, 2nd edition, Boston, Massachusetts, Houghton Mifflin Harcourt, 663 p.
- Pappantoniou, A. 1983. Aspects of the life history of the cutlips minnow *Exoglossum maxillingua* (Pisces: Cyprinidae). PhD thesis, Fordham University, New York.

- Pappantoniou, A., G. Dale, and R.E. Schmidt. 1984a. Aspects of the life history of the Cutlips Minnow, *Exoglossum maxillingua*, from two eastern Pennsylvania streams. *Journal of Freshwater Ecology* 2(5):449-457.
- Pappantoniou, A., R.E. Schmidt, and G. Dale. 1984b. Ecology and life history of the Cutlips Minnow, *Exoglossum maxillingua*, from a southeastern New York stream, *Northeastern Environmental Science* 3(2):75-79.
- Rivard, G. 2011. « Impacts et justifications », in Guide de gestion des eaux pluviales stratégies d'aménagement [...] [online], ministère du développement durable, de l'environnement et des parcs, Quebec, « Collections de BAnQ ».
- Schultz, R., and E. Dibble. 2012. Effects of invasive macrophytes on freshwater fish and macroinvertebrate communities: the role of invasive plant traits. *Hydrobiologia* 684(1):1-14.
- Scott, W.B., and E.J. Crossman. 1974. Freshwater Fishes of Canada, Bulletin 184, Fisheries Research Board of Canada, Ottawa, Ontario, 966 p.
- St-Hilaire, A., S. Duchesne, and A. Rousseau. 2016. Floods and water quality in Canada: A review of the interactions with urbanization, agriculture and forestry. *Canadian Water Resources Journal/Revue Canadienne des Ressources Hydriques* 41(1-2):273-287.
- Toner, G.C. 1943. Ecological and geographical distribution of fishes in eastern Ontario. Ontario 91 p. M.A. Dissertation. University of Toronto.
- Van Duzer, E.M. 1939. Observations on the breeding habits of the cutlips minnow, *Exoglossum maxillingua*. *Copeia* 1939(2):65-75.
- Wood, P.J., P.D. Armitage. 1997. Biological effects of fine sediment in the lotic environment. *Environmental management* 21(2): 203-217.
- Working Group on the State of the St. Lawrence Monitoring. 2019. Overview of the state of the St. Lawrence 2019. St. Lawrence Action Plan. Environment and Climate Change Canada, Quebec Ministry of the Environment, the Fight Against Climate Change, Wildlife and Parks (MELCCFP) [Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs], Parks Canada, Fisheries and Oceans Canada, Stratégie Saint-Laurent, 60 p.
- Zuwerink, D.A., D.J. Jude, and J.E. Gannon. 2019. Behavioral interactions between the nonindigenous round goby and young-of-the-year yellow perch. *Biological Invasions* 21(12): 3633-3639.

Appendix A: sites where the Cutlip Minnow has been collected in Quebec

Watershed	Water body	Years observed
Bayonne River	Bayonne River	1971
Bayonne River	Bibeau Creek	1971
Beaudette River	Beaudette River	1946, 1970, 1971
Bécancour River	Bécancour River	1935, 1964, 2005, 2019
Bécancour River	Blanche River	2011
Bécancour River	Bourbon River	2019
Bécancour River	Bullard River	1934, 1997, 2012, 2015
Bécancour River	Lacasse River	2020
Bécancour River	Morency River	2012
Bécancour River	Noire River	2011, 2019
Bécancour River	Palmer River	1996
Bécancour River	Perreault Creek	2011
Boyer River	Boily Creek	1971
Boyer River	North Boyer River	1971, 1992, 1995, 2005, 2020
Boyer River	South Boyer River	1971, 2020
Boyer River	Boyer River	1941, 1971, 1992, 2002, 2007
Du Cap Rouge River	Du Cap Rouge River	2011
La Chaloupe River	La Chaloupe River	1941, 1971
Champlain River	Champlain River	2022
Châteauguay River	Tributary of Allen Creek	1976
Châteauguay River	Allen Creek	1976, 2006, 2009, 2011, 2012
Châteauguay River	Aux Anglais River	1976, 1996, 2006, 2009, 2010, 2011, 2012, 2013, 2014, 2016, 2018, 2019
Châteauguay River	Châteauguay River	1941, 1942, 1946, 1960, 1961, 1963, 1975, 1976, 2006, 2016, 2017, 2021
Châteauguay River	Collins Creek	1941, 1963
Châteauguay River	Dewitt Creek	1970, 1976
Châteauguay River	Hinchinbrooke River	1941, 1961, 1963, 1976, 1989, 2006, 2012, 2021
Châteauguay River	Tributary of Mitchell Creek	1976
Châteauguay River	Mitchell Creek	1963, 1976, 2002, 2006
Châteauguay River	Noire River	2015
Châteauguay River	Oak Creek	1967, 1976, 2006, 2019
Châteauguay River	East aux Outardes River	1976, 1991, 1996, 2002, 2006, 2014
Châteauguay River	Robson Creek	1976, 2009
Châteauguay River	Trout River	1941, 1942, 1976, 1996, 2006, 2010, 2011, 2012, 2014, 2016

Watershed	Water body	Years observed
Chaudière River	Southeast des Abénaquis River	2003
Chaudière River	Southwest des Abénaquis River	2000
Chaudière River	Beaurivage River	1964, 1996, 2001, 2003, 2005, 2006, 2008, 2010, 2012, 2021
Chaudière River	Tributary of the Beaurivage River	1999
Chaudière River	Boutin Creek	2004
Chaudière River	Bras d'Henri (River)	1980, 2012
Chaudière River	Bras Saint-Victor (River)	1965, 1994, 1999, 2002
Chaudière River	Calway River	1994, 2012
Chaudière River	Chassé River	1963
Chaudière River	Chaudière River	1941, 1949, 1976, 1994, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005
Chaudière River	Tributary of the Chaudière River	2020
Chaudière River	Du Cinq River	1977, 2011
Chaudière River	Cugnet River	1998, 2010
Chaudière River	Cumberland River	2005
Chaudière River	Des Acadiens Creek	1998
Chaudière River	Décharge du Dix (Creek)	1975
Chaudière River	Doyon Creek	1994
Chaudière River	Drolet River	2020
Chaudière River	Famine River	1999, 2002, 2005
Chaudière River	Filkars River	1980
Chaudière River	Fortin-Dupuis Creek	1998
Chaudière River	Glen River	2020
Chaudière River	Kokombis River	2020
Chaudière River	Du Loup River	2001, 2002, 2006
Chaudière River	Ludgine River	2020
Chaudière River	Madisson Creek	2020
Chaudière River	Du Monument River	2002
Chaudière River	Du Moulin River	2001, 2002, 2005, 2012
Chaudière River	Nebnellis River	2020
Chaudière River	O'Hara Creek	2020
Chaudière River	Oliva Creek	2006
Chaudière River	Des Ormes Creek	1996
Chaudière River	Aux Pins River	2006
Chaudière River	Du Portage River	2000
Chaudière River	Pouliot River	1980, 2012
Chaudière River	Pozer River	1991, 1998, 1999

Watershed	Water body	Years observed
Chaudière River	Rivière Prévost-Gilbert (Creek)	2001
Chaudière River	Samson River	2020
Chaudière River	Tring Creek	1977
Chaudière River	Vachon River	2003
Chaudière River	Vallée River	1963, 2002
Small du Chêne River	Creuse River	1982, 1984
Small du Chêne River	De l'Espérance Creek	1982, 1984
Small du Chêne River	Aux Ormes River	1941, 1984
Small du Chêne River	Small du Chêne River	1941, 1982, 1984, 2013, 2018
Du Chêne River	Du Bois-Clair River	1971
Du Chêne River	Bras d'Edmond (River)	1971
Du Chêne River	Bras Des Boucher (Creek)	1971
Du Chêne River	Aux Cèdres River	1971
Du Chêne River	Du Chêne River	1971, 1997, 2002, 2005, 2010, 2012
Du Chêne River	Aux Chevreuils River	1971, 1986, 1987, 2003, 2006
Du Chêne River	Henri River	1971, 1986, 1997, 2002, 2005, 2008, 2010, 2012
Du Chêne River	Huron River	1971, 2008
Du Chêne River	Aux Ormes River	1971
Du Chêne River	Branche Rémi-Plante (Creek)	1971
Du Chêne River	Unnamed Creek	1971
Du Chêne River	Du Chêne River	1965, 2022
	La Petite Rivière (River)	1965, 1970
Chicot River	Tributary of the Chicot River	1971
Chicot River	Chicot River	1971, 2021
Chicot River	Outlet stream of Dupras Lake	1971
Chicot River	Saint-André Creek	1971
Du Chicot River	du Chicot River	2017
Delisle River	Delisle River	1936, 1938, 1942, 1946, 1970, 2021
Etchemin River	Le Bras River	1962, 1971, 1997, 1998, 2003, 2009, 2010, 2018
Etchemin River	Etchemin River	1962, 1963, 1991, 1996, 2000, 2002, 2005, 2006, 2009, 2010, 2018, 2019, 2020, 2022
Etchemin River	Fourchette Creek	1962, 2001, 2011, 2019
Etchemin River	Longchamps Lake	2018
Ferrée River	Ferrée River	1941, 2012, 2016
Ferrée River	Joncas River	2007

Watershed	Water body	Years observed
St. Lawrence River	St. Lawrence River (Lake Saint-Pierre archipelago area)	1971
St. Lawrence River	St. Lawrence River (Grande Île area)	1941, 1942, 1971, 1975, 1979, 1980
St. Lawrence River	St. Lawrence River (Grondines – Donnacona section)	1996, 2002
St. Lawrence River	Bussier Creek	2006
St. Lawrence River	Du Moulin Creek	2006
St. Lawrence River	Du Moulin River	2006
St. Lawrence River	Saint-Patrice Creek	2006
St. Lawrence River	Lake St. Francis	1938, 1975, 1976, 1994, 2003
St. Lawrence River	Ottawa River	1941, 1976
St. Lawrence River	Lake Saint-Louis	1941, 1942
St. Lawrence River	Aux Ours Channel	1971
St. Lawrence River	St. Lawrence River (Montreal – Sorel section)	1941, 1967, 1972, 1973, 1974, 1976, 1977, 1983, 1989, 2001, 2015
Gentilly River	Le Bras Creek	1941, 1984
Gentilly River	Southwest Gentilly River	1982, 1984
Gentilly River	Gentilly River	1982, 1984, 2013
Jacques-Cartier River	Jacques-Cartier River	1981, 1986, 1990, 1994, 2001, 2002, 2003, 2013
Kamouraska River	Kamouraska River	1941
Kamouraska River	Saint-Denis River	1941
Kamouraska River	Unnamed Creek	1941
L'Assomption River	Abercromby River	2007
L'Assomption River	De l'Achigan Lake	2007
L'Assomption River	De l'Achigan River	1968, 2007, 2008, 2015, 2016
L'Assomption River	L'Assomption River	2014, 2015
L'Assomption River	Connelly Creek	2016
L'Assomption River	Outlet stream of Cromwell Lake	2016, 2018, 2019, 2020
L'Assomption River	Cromwell Lake	2007, 2008, 2018, 2020, 2021
Maskinongé River	Maskinongé River	1967, 2021
Des Mères River	Des Mères River	2022
Nicolet River	L'Aulnière Creek	2019
Nicolet River	À Bissonnette Creek	2019
Nicolet River	Bulstrode River	1977, 1987, 1989, 2012
Nicolet River	Tributary of the Bulstrode River	2012
Nicolet River	Danville River	2018
Nicolet River	Francoeur Creek	1933, 1935, 2019

Watershed	Water body	Years observed
Nicolet River	Rivière L'Abbé (Creek)	2012
Nicolet River	Landry River	2018
Nicolet River	Chez Larrivée River	2018
Nicolet River	Michaud Creek	2012
Nicolet River	Centre Nicolet River	1977, 2018
Nicolet River	Tributary of the Northeast Nicolet River	2018
Nicolet River	Northeast Nicolet River	1977, 2018
Nicolet River	Southwest Nicolet River	1977, 2018
Nicolet River	Les Trois Lacs (lakes)	2016
Nicolet River	Nicolet River	1933, 1977, 1984, 2013, 2015, 2018, 2021
Nicolet River	Parent Creek	2012
Nicolet River	Perreault Creek	2012
Nicolet River	Pinard Creek	2018
Nicolet River	Des Pins River	1933
Nicolet River	Plante Creek	2012
Nicolet River	Pouliot Drain	2019
Nicolet River	Des Rosiers River	1935
Nicolet River	Smith Creek	2019
Aux Orignaux River	Aux Orignaux River	1982, 1984, 2019
Aux Orignaux River	Santario Creek	1982, 1984
Ouelle River	Ouelle River	1964, 1968, 1983, 1984, 1985, 1986, 1987, 1988, 1989, 1990, 1991, 1992, 1993, 1999, 2000, 2001, 2002, 2004, 2005, 2006, 2007, 2008, 2009, 2013
Ottawa River	Avalanche Creek	1998, 2002, 2004, 2005, 2006, 2008, 2009
Ottawa River	Barron Lake	1985
Ottawa River	Beaven River	2007
Ottawa River	Bellefeuille River	2007, 2016
Ottawa River	Bonniebrook Creek	2007
Ottawa River	Outlet stream of Brochet Lake	2001, 2007
Ottawa River	Cachée River	2007
Ottawa River	Chamerry Creek	1976
Ottawa River	Dalesville River	1976
Ottawa River	Des Deux Montagnes Lake	1976
Ottawa River	Du Diable River	1968, 2022
Ottawa River	Outlet stream of Echo Lake	2016
Ottawa River	De l'Est River	1987
Ottawa River	Gemont Lake	1967
Ottawa River	À la Graise River	1972

Watershed	Water body	Years observed
Ottawa River	Grand Ruisseau	2005
Ottawa River	Tributary of Hudon Lake	1964
Ottawa River	Tributary of Iroquois Lake	2007
Ottawa River	Iroquois Creek	1981, 2006, 2007, 2018
Ottawa River	Jackson Creek	2007, 2016
Ottawa River	La Rivière Lake	1967
Ottawa River	Laroche River	2001, 2007
Ottawa River	Larose Creek	2007
Ottawa River	Laurel Lake	1988
Ottawa River	Louisa Lake	1963, 1983
Ottawa River	Mercier Creek	2004, 2005, 2007, 2008
Ottawa River	Aux Mulets River	2007, 2016
Ottawa River	Noir Creek	2002, 2007
Ottawa River	Du Nord River	1991, 1992, 2007, 2020, 2022
Ottawa River	De l'Ouest River	1975, 1976, 1988
Ottawa River	Perdue River	2007
Ottawa River	Little Saint-Denis Lake	1966
Ottawa River	De la Petite Nation River	2013
Ottawa River	Preston River	2018
Ottawa River	À la Raquette River	1964
Ottawa River	À Regimbald Creek	2007
Ottawa River	Rigaud River	1964, 1965, 1966, 1972, 2021
Ottawa River	Rouge River	1941, 1998, 2000
Ottawa River	Saint Marie Lake	1991
Ottawa River	Saint-Denis Lake	1960, 1966, 2022
Ottawa River	Sainte-Marie Lake	2008
Ottawa River	Outlet stream of Bouchette Lake	2007
Ottawa River	À Simon River	2009, 2016, 2022
Ottawa River	Sir-John Lake	1992, 1994
Ottawa River	William Lake	1994
Ottawa River	Williams Creek	1992, 1999, 2000, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009
Port Joli River	Port-Joli River	1998
Portneuf River	Portneuf River	1999
Portneuf River	Outlet stream of Sergent Lake	2002
Richelieu River	Beauvais Creek	1965
Richelieu River	Richelieu River	1965, 1970, 1993, 1999, 2011, 2012
Richelieu River	Canal Saint-Bruno (Creek)	1988
Saint-Charles River	Saint-Charles River	1941
Sainte-Anne River	Blanche River	2002, 2013

Watershed	Water body	Years observed
Sainte-Anne River	Charest River	1979
Sainte-Anne River	Niagarette River	1995, 2002
Sainte-Anne River	Noire River	1995
Sainte-Anne River	Sainte-Anne River	1979, 2012, 2013
Saint-François River	South aux Bluets River	2013
Saint-François River	Aux Bluets River	1996
Saint-François River	Daoust Drain	1932
Saint-François River	Miller Creek	2013
Saint-François River	Saint-François River	1974, 2009
Saint-François River	Du Saumon River	1976, 2009
Saint-François River	Ulverton River	1932, 1935
Saint-François River	Aux Vaches River	1944
Saint-François River	Vaseux Creek	1999, 2013
Aux Saumons River	aux Saumons River	2008
Du Sud River	Bras Saint-Michel (River)	1941, 1998, 2005, 2016, 2020
Du Sud River	Bras Saint-Nicolas (River)	1941, 1975, 1980, 1997, 1998, 2003, 2007, 2010, 2012, 2013, 2015, 2017
Du Sud River	Campagna Drain	1982, 2005
Du Sud River	De la Chute Creek	2001
Du Sud River	Grand fossé	1983
Du Sud River	Minguy River	2011, 2013
Du Sud River	Morigeau River	2005, 2007, 2009, 2013
Du Sud River	Outlet stream of Pain De Sucre Lake	2006
Du Sud River	Des Perdrix River	2000, 2013, 2015
Du Sud River	Des Prairies Creek	1986, 2012
Du Sud River	Du Sud River	1940, 1941, 1964, 1992, 1996, 1997, 2004, 2005, 2013, 2015, 2016, 2018, 2019
Tortue River	Southeast Tortue River	1998, 2008
Trois-Saumons River	Trois-Saumons River	2019
Yamachiche River	Yamachiche River	1972, 1973, 2018, 2021
Yamaska River	Saint-David River	1970

Update of the table in the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) status report (COSEWIC 2013), based on data from the Quebec Ministry of the Environment, the Fight Against Climate Change, Wildlife and Parks, the Ontario Ministry of Natural Resources's Natural Heritage Information Centre, Fisheries and Oceans Canada, and other contributors.

Appendix B: sites where the Cutlip Minnow has been collected in Ontario

Watershed	Water body	Years observed
St. Lawrence River (Cardinal section)	St. Lawrence River	1981, 1994, 2008, 2009, 2018, 2020
St. Lawrence River (Cornwall section)	Rotary Creek	2008, 2009, 2017, 2018
St. Lawrence River (Cornwall section)	St. Lawrence River	1994, 1995, 2001, 2003, 2004, 2008, 2009, 2015, 2016, 2017, 2018, 2019, 2020
St. Lawrence River (Ivy Lea section)	St. Lawrence River	1936, 1937, 1967, 1970, 1994
St. Lawrence River (Morrisburg section)	Nash Creek (Hoasic Creek)	1938, 2008
St. Lawrence River (Morrisburg section)	St. Lawrence River	2009, 2016, 2017, 2018, 2020
Ottawa River	Little Rideau Creek	1978, 1989, 2004, 2010
Ottawa River	Ottawa River	1978, 1989, 2001
Upper St. Lawrence	North Raisin River	1973, 1989, 2004, 2009
Upper St. Lawrence	Raisin River	1973, 1989, 2004, 2008, 2009, 2013
Upper St. Lawrence	Delisle River	1936, 1938, 1942, 1946, 1970, 2021

Update of the table in the Committee on the Status of Endangered Wildlife (COSEWIC) status report (COSEWIC 2013), based on data from the Ontario Ministry of Natural Resources's Natural Heritage Information Centre, Fisheries and Oceans Canada, and other contributors.

Appendix C: threat assessment categories

Likelihood of occurrence	Definition
Known or very likely to occur	There is 91 to 100% chance that this threat is or will be occurring
Likely to occur	There is 51 to 90% chance that this threat is or will be occurring
Unlikely	There is 11 to 50% chance that this threat is or will be occurring
Remote	There is 1 to 10% or less chance that this threat is or will be occurring
Unknown	There are no data or prior knowledge of this threat occurring now or in the future

Level of impact	Definition
Extreme	Severe population decline (71 to 100%) with the potential for extirpation
High	Substantial loss of population (31 to 70%) or threat would jeopardize the survival or recovery of the population
Medium	Moderate loss of population (11 to 30%) or threat is likely to jeopardize the survival or recovery of the population
Low	Little change in population (1 to 10%) or threat is unlikely to jeopardize the survival or recovery of the population
Unknown	No prior knowledge, literature, or data to guide the assessment of threat severity on population

Causal certainty	Definition
Very high	Very strong evidence that threat is occurring and the magnitude of the impact to the population can be quantified
High	Substantial evidence of a causal link between threat and population decline or jeopardy to survival or recovery
Medium	There is some evidence linking the threat to population decline or jeopardy to survival or recovery
Low	There is a theoretical link with limited evidence that threat is leading to a population decline or jeopardy to survival or recovery
Very low	There is a plausible link with no evidence that the threat is leading to a population decline or jeopardy to survival or recovery

Threat occurrence	Definition
Historical	A threat that is known to have occurred in the past and negatively impacted the population
Current	A threat that is ongoing, and is currently negatively impacting the population
Anticipatory	A threat that is anticipated to occur in the future, and will negatively impact the population

Threat frequency	Definition
Single	The threat occurs once
Recurrent	The threat occurs periodically, or repeatedly

Continuous	The threat occurs without interruption
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Threat extent	Definition
Extensive	71 to 100% of the population is affected by the threat
Broad	31 to 70% of the population is affected by the threat
Narrow	11 to 30% of the population is affected by the threat
Restricted	1 to 10% of the population is affected by the threat

Appendix D: record of cooperation and consultation

Management plans are to be prepared in cooperation with other jurisdictions, organizations, and affected parties and individuals, as outlined in section 66 of the *Species at Risk Act*. Fisheries and Oceans Canada has used a process involving the Quebec Cyprinids and Small Percids Recovery Team and an expert from Ontario Ministry Natural Resources (OMNR). Indigenous communities or organisations with an interest for Cutlip Minnow and its habitat were also invited to share their knowledge on the species.

Consultations on the draft management plan occurred through letters to provincial and federal ministries, as well as to the Indigenous communities and organizations concerned in Quebec and Ontario.

Appendix E: acronyms

AGRCQ	Association des gestionnaires régionaux des cours d'eau du Québec [Association of Regional Watercourse Managers of Quebec]
CDPNQ	Centre de données sur le patrimoine naturel du Québec [Quebec natural heritage data centre]
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
DFO	Fisheries and Oceans Canada
MAPAQ	Ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec
MELCCFP	Ministère de l'Environnement et de la Lutte contre les changements climatiques
OFAH	Ontario Federation of Anglers and Hunters
OMECP	Ontario Ministry of the Environment, Conservation and Parks
OMNR	Ontario Ministry Natural Resources
PC	Parks Canada
RCM	Regional county municipality
ROM	Royal Ontario Museum
SARA	<i>Species at Risk Act</i>